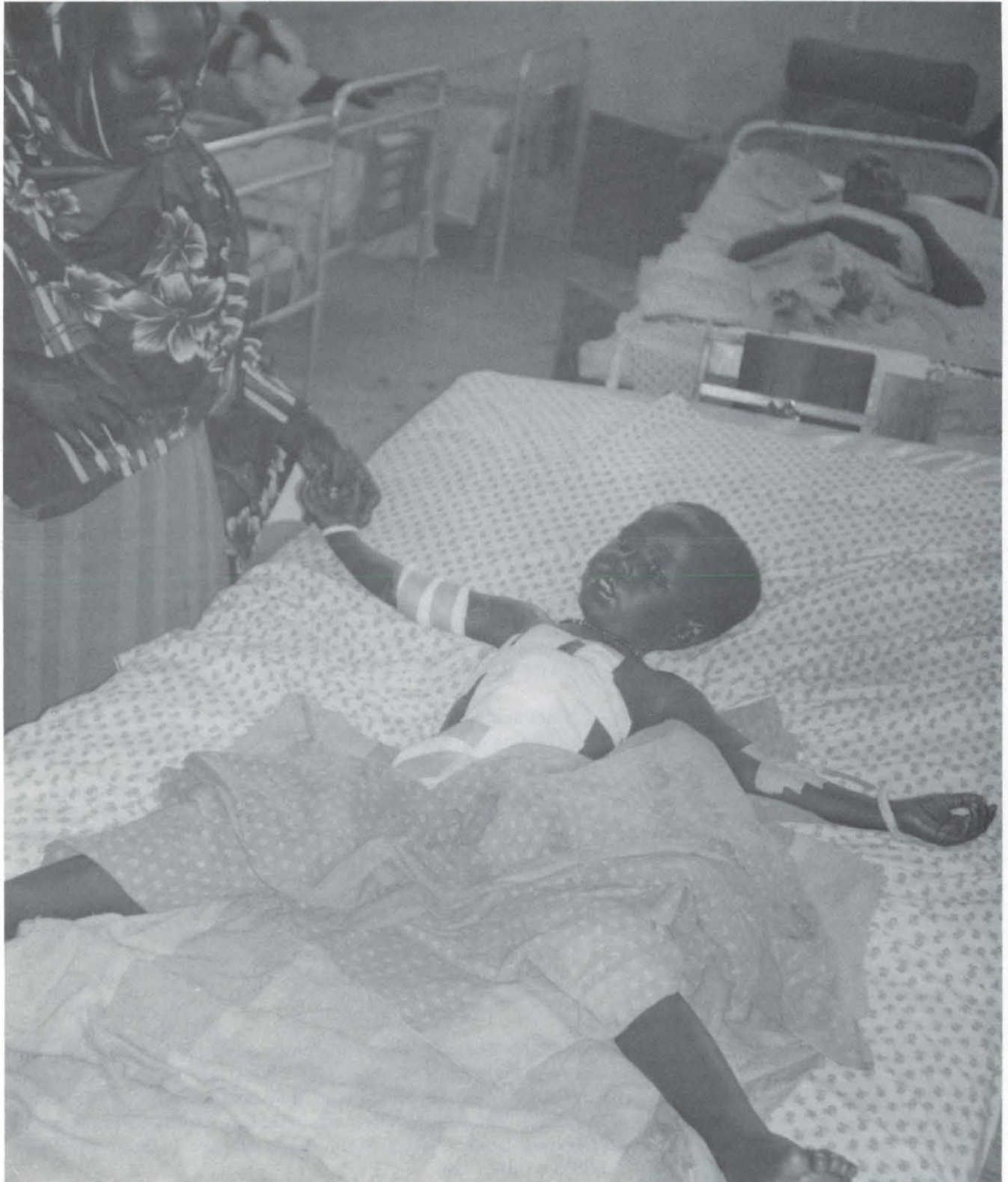


NAVY MEDICINE

March-April 1993



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COVER: In Somalia, this young boy was wounded in the abdomen when a spent bullet fell from the sky. "When are you going to take the guns away from the people who shot me," he asked a U.S. Navy physician. That medical officer was in the east African nation as part of Operation Restore Hope. Story begins on page 1. Photo by CAPT Michael Cowan, MC.

Reminiscences of Operation Restore Hope

As the C-5 banked for a tactical approach to Mogadishu Airport, I didn't know whether to think the precautions were a bit melodramatic, or to allow the cold little finger of fear creeping up my neck tell me its message. After flying over 11,000 miles through 11 time zones, and with four in-flight refuelings, we had no idea how friendly our reception would be. While the evasive turns of the huge aircraft as we descended seemed foreboding, my overriding emotion was curiosity and expectation. How would reality compare to the TV images of Somalia? How would it feel to be in a nation with total anarchy and no government, a place where warring clan factions and "Mad Max" criminals ran around the streets with crew-served automatic weapons? I had never seen starvation on a large scale. How would it affect the troops, the medical staff, and me?

And then there was the biggest question of all: How would we set up a medical system for a force of as many as 24,000 Americans in a few short weeks in a place with no infrastructure, where every drop of water had to be imported, and aeromedical evacuation legs to Europe would be 4,500 miles long? We would have to do everything from scratch.

As a last minute addition to the Joint Task Force, I had joined Opera-

tion Restore Hope with some trepidation. Putting together a tri-service medical system in a remote place is a challenge at best. In a dangerous and disease-ridden country like Somalia, "challenge" somehow didn't reflect the concerns I felt. The only reassuring point in the beginning was that the Tripoli Amphibious Readiness Group with an augmented medical department was already lying ready off the coast.

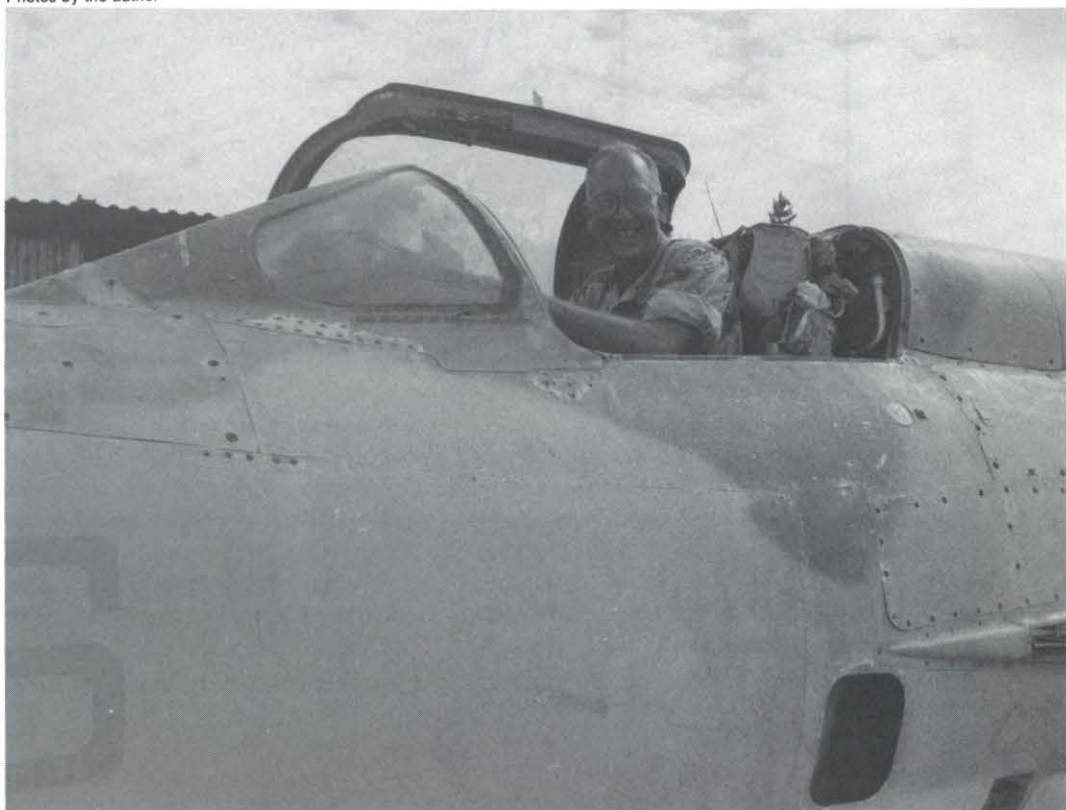
Medical Threat and Mission

We expected to receive numbers of casualties from hostile fire, and even more injuries during the large scale

movement of men and materiel undergoing a major deployment. The environment is hot, harsh, and unrelenting. The physical and psychological stresses were high.

But the one prevailing concern was infectious disease. In the best of times, Somalia is one of the most disease-rich environments on earth. Malaria, dengue, and other vector-borne diseases, various flavors of dysentery (bacterial, amoebic), tuberculosis, meningitis, and a variety of tropical illnesses are all endemic. AIDS is thought to be endemic, but after years of anarchy, reliable estimates of the threat are unobtainable.

Photos by the author



The author in the driver's seat of his "new" MIG. Much of Somalia is a junkyard of discarded Soviet aircraft and weapons.



Snapshot of Somalia

One prevailing impression of Somalia is a place where everything of any value has been removed and taken out of the country and sold for arms. Even the copper wiring has been stripped from the walls of buildings from which even the roofs have been removed. Telephone and power lines have been

torn down. There is no power, no lights, no water, and no sewer systems. Raw sewage runs in the streets. After an inconclusive civil war, an inopportune drought, and a thorough looting of the country, the survivors are now reduced to fighting over welfare grain and rice.

As a result, theft has become the

major industry. The throngs of people along the roadways soon discovered that Americans would not shoot petty thieves. The ruses for stopping convoys then became ingenious. Rock throwing, having children run in front of vehicles, and other diversions, no matter how dangerous, were used to create mob scene opportunities to



A feeding center in Mogadishu

steal. Anything was fair game. Polo glasses and Ray-Bans snatched from the faces of troops are all over Mogadishu.

The flavor of anarchy is almost burlesque and gleefully evil. Before we arrived, Mad Max characters roared around the streets in battered old pickups with machine guns, cannons, and recoilless rifles bolted to the truck beds. Nothing about the zaniness disguised the malevolence. Anyone who took it into his mind to kill another, could; there was no law against it. The smell of decomposing bodies is always in the air, a reminder of the grim reality of unrestrained civil war and lawlessness.

The sound of sporadic small and large arms gunfire was routine. We

quickly learned the difference between AK-47 and M-16 fire, but it took a few days to identify some of the heavier mortar and cannon sounds. The occasional artillery barrage on the horizon was always entertaining, especially at night.

Somalis have a quiet, soft dignity peculiar to themselves. We were the most interesting show in town and wherever there were Americans, crowds swarmed to watch. They would camp and live outside a gate just to observe us. Many were curious, some happy to see us, others looking for a job, a handout, or an opportunity to steal. The young gang thugs were blatantly hostile. After all, we were there to take away their livelihood.

In the typical way of humans every-

where, beauty can be found in the midst of horror. We saw it in the smiling faces of the children who waved to us in the streets, or in the bright clothing of the Somali women whose shawls, headdresses, and robes are made of colors and patterns too brilliant to be found in nature.

I dreaded seeing the feeding camps. I doubted my courage to witness human suffering on that scale. But the reality was overall an uplifting experience. The dedication of the humanitarian relief workers must be seen to be believed. Watching them care for the starving erased all my reservations about being away from my own family at Christmas.

There were hopeless cases in the camps. But I could also see those who

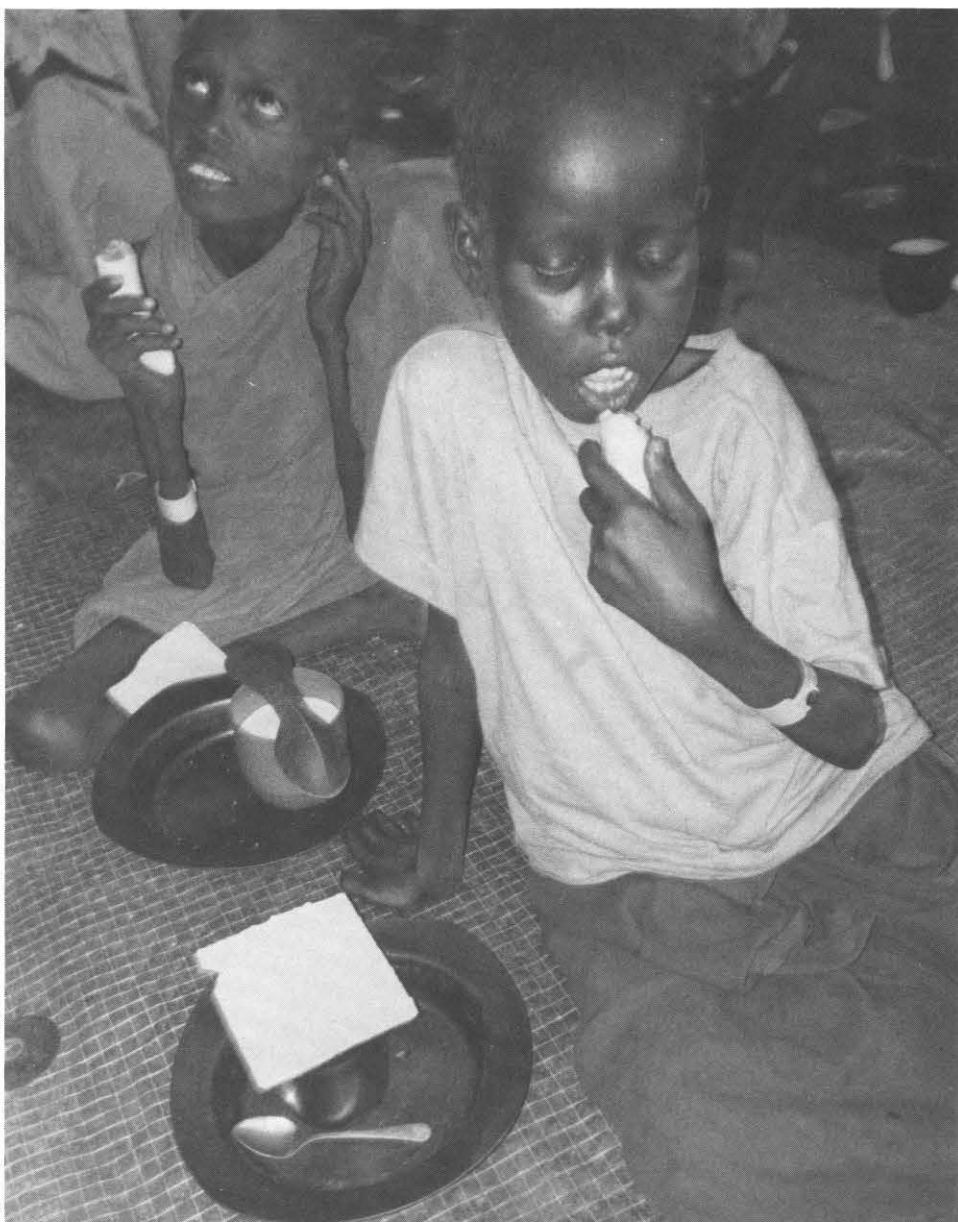
Surrounded by his family, this gunshot victim recovers in a Baidoa hospital. *Right: Providing security for feeding stations was one of the chief missions of U.S. forces in Somalia. The child in the foreground has already begun to recover from severe malnutrition. The other youngster was a recent arrival. Far right: Somali state-of-the-art surgery as performed in an operating room at Mogadishu's Keysani Hospital.*



had begun feeding in time and were turning the corner toward life. It doesn't take long to fatten up a kid. A few days of balanced meals, and children are on the way to growing up again. My discussions with relief workers clarified the situation for me: the feeding camps work only as long as there is someone to provide security. In my opinion, U.S. forces did and are doing a first-class job of that.

American forces ashore lived in extremely primitive conditions. There was no way to abate the ferocity of the weather. Sailors, soldiers, and marines sweltered under flak jackets and helmets. Walking through sand was exhausting. Despite a caloric intake of up to 6,000 calories per day, most people still lost weight rapidly.

Amenities were minimal. My canteen was my friend . . . and my shower. Slit latrines don't flush. The wind blew through the tent at night leaving us snoring through the sand it deposited in our mouths. We ate lots of MRE's. When asked what they thought was



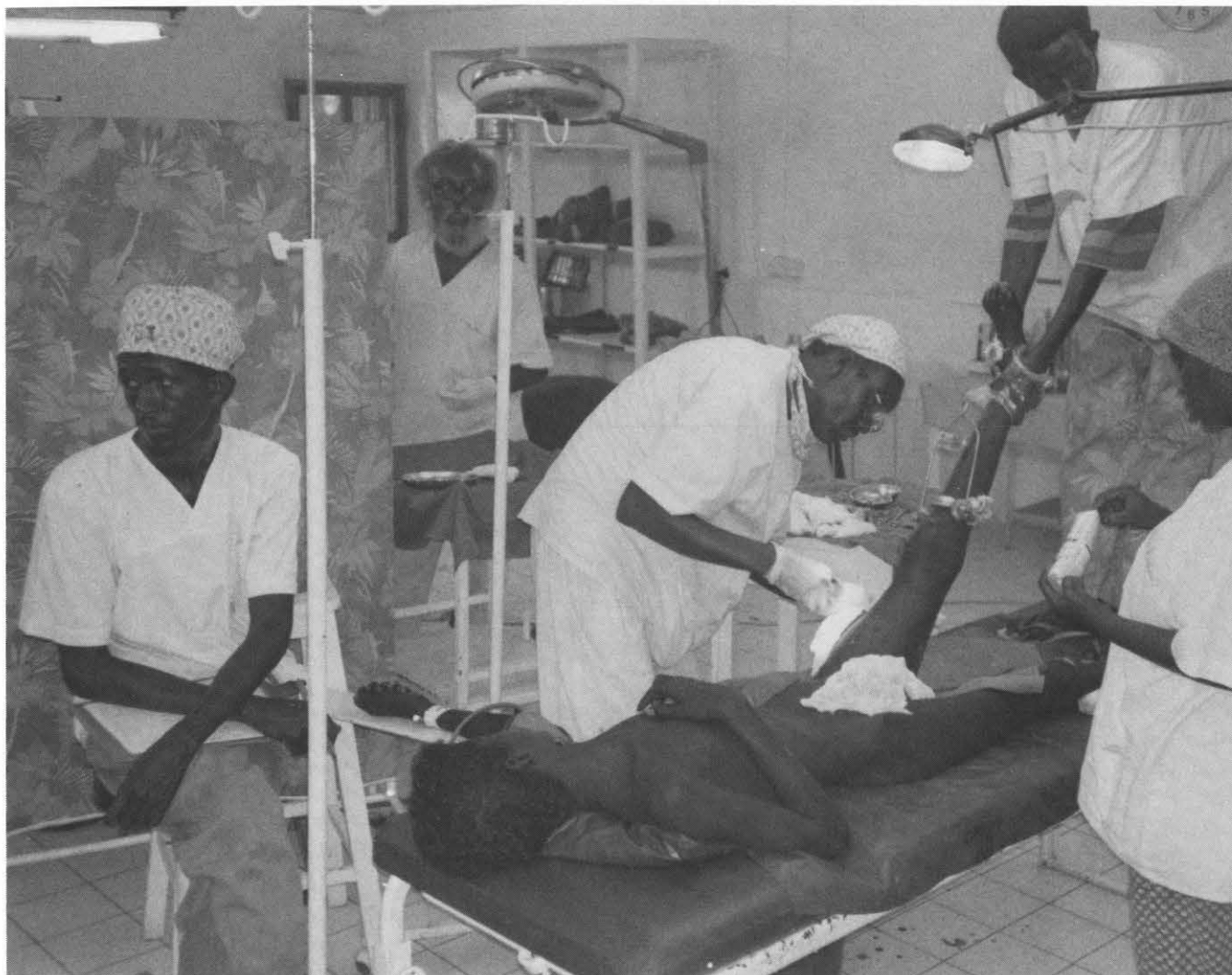
the greatest threat to their health, over half the marines surveyed in Kismayu responded, "eating three MRE's every day for over a month." Despite the hardships, I never heard a complaint. People worked relentlessly all their waking hours, stopping only to sleep. There was a sense of purpose and dedication to the task that was all-encompassing. We didn't miss the amenities much because there was so little spare time to notice.

There were medical facilities and health care providers throughout southern Somalia when we arrived. Their biggest problem had been the lack of opportunity to perform their

jobs unmolested. Digfer and Keysani are the hospitals in Mogadishu I know best, and I also saw hospitals in Baidoa and Bardera.

Each hospital had a humanitarian sponsor such as the International Medical Corps, International Committee of the Red Cross (ICRC), or Swedish Relief, and had Somali doctors and nurses working with the international relief teams. The mission of U.S. medical forces was not to be another humanitarian relief agency, but to support the U.S. forces who would make and then keep the peace so other relief agencies could work.

Digfer Hospital is operated under



the auspices of the International Medical Corps staffed by American physicians, who provide health care and train Somali physicians under impossibly adverse conditions. This 800-bed hospital, located in southern Mogadishu, tries to care for patients despite shortages of everything reasonably required to do so. It has electrical power only 2-3 hours a day, no water or sewage, almost no medications, the most rudimentary laboratory and ancillary services support, and insufficient security to remove squatters living in patient beds. Despite all this, it still manages to provide care and save lives.

Keysani Hospital, located in north Mogadishu, is a trauma hospital run by the ICRC and Red Crescent. Since opening in February 1992, the hospital has performed over 8,000 operations,

mostly for gunshot wounds. The physicians are all Somalis who, with the support of the ICRC and Red Crescent, have made a functional hospital out of an abandoned prison.

Before the arrival of U.S. and coalition forces, the ICRC hospital in Baidoa had very few patients. It was too dangerous for people to venture out of their homes for care. Now it has all the business it can handle.

A Red Cross-sponsored hospital in remote Bardera had no physicians, only a young intensive care nurse from Belgium. Nevertheless, patients with gunshot wounds of the head, abdomen, and chest were all receiving what care could be provided. With desperately few resources, lives were being saved.

The cultural change from lawlessness to order is not seamless, and not

seen by all to be in their best interest. Many of the humanitarian agencies have experienced increased danger and frustration as the presence of the U.S. and coalition forces begins to alter the status quo. But the process is working.

U.S. Medical Operations

The operation is currently in its transition phase, handing off responsibility to the coalition forces of other nations. Therefore we can begin to assess the success of the U.S. medical support mission. The bottom line is that not very much happened. We had little disease and fewer injuries. As of this writing, casualties remain light. This has not been a matter of luck, but rather attention to detail.

Military operations are being carried out with meticulous attention to



Clausewitzian principles. U.S. forces deploy, move, and act with overwhelming force. There are no fair fights. Few opportunities to oppose Americans are offered. It is not love of their fellow man that convinces criminals to cooperate. While in Somalia, I noted that a strong presence received respect and the armed combatants generally behaved themselves.

The deployment was rapid and provided ample opportunity for accidents. Command attention to safety, and the absence of alcohol in the theater of operations combined to keep accidental injury to a minimum.

Disease rates among American forces remain astonishingly low, again more due to hard work than luck. Computer projections called for unprotected, unprepared troops to have disease rates making whole units ineffective. But that didn't happen. The same sort of command attention to avoiding battle casualties was focused on disease and injury prevention. A few cases of shigella diarrhea, 35 cases of malaria, and a similar number of dengue occurred, but secondary transmission and epidemics never materialized; combat effectiveness was never threatened.

Skeptics might counter that you can't prove a negative and that we were just lucky to avoid more injury and disease. Perhaps we can attribute it to some other serendipity. But you don't have to look far to demonstrate the results of lax discipline. A fever outbreak in one outlying area was traced to a breakdown of preventive and prophylactic discipline. The problem was identified, command compliance re-emphasized, the vectors eradicated, and prompt treatment of patients resulted in termination of the mini-epidemic.

It is clear to me that American forces escaped decimation from disease through command emphasis on prevention, epidemiological monitoring, and rapid diagnosis and treatment of disease. The lessons from Operations Desert Shield/Storm paid off here.

Two operational medicine subspecialties never get much press, but should: planning and logistics. Medical planning for Operation Restore Hope never stopped. Modifications of the medevac plan were still being sketched on a napkin enroute to Mogadishu.

Managing medical logistics is complex and difficult. Medical assets have

to compete with all the other imperatives of an operation. Every plane that carries medical equipment, supplies, or personnel does *not* carry beans or bullets for the operation. Medical logisticians are the quiet guys whose job nobody quite understands. But I now have an inkling.

The concept of operations for medical support may be of interest to tacticians. Imagine a hub of operation with radii at 7:00, 8:00, 8:30, and 11:00, each of which averages over 150 miles distance. There are few functional roads and travel at night is dangerous.

We established a "scoop and run" system which depended heavily on a robust medevac system able to deliver seriously ill or injured patients quickly to the medical care they required. Echelon I battalion aid stations in remote areas relied on minimal stabilization and rapid helicopter evacuation to centrally located hospital facilities in Mogadishu. The success of the plan depended on helicopters getting there on time, every time. Command willingness to dedicate helicopters to the task made it successful.

The first referral hospital in the country was USS *Tripoli* whose Amphibious Readiness Group (ARG)

Left: Soviet-built howitzers confiscated by the Marines.

was off station in Somalia from the beginning of the operation. She took on seven seriously injured Somalis the first day of operation and never stopped running after that.

In mid-December *Tripoli* was augmented by the 1st FSSG Casualty Collecting and Clearing Company. The two proved to be a highly effective team. *Tripoli* continued to care for most of the surgical patients while the USMC collecting and clearing company took the majority of infectious disease cases.

The Joint Forward Laboratory, under the sponsorship of the Naval Medical Research Institute, was attached to the collecting and clearing company and provided a capability that most Stateside hospitals would envy. Despite the harsh conditions, with blowing sand which could find the innermost lens of any microscope, the Joint Forward Lab provided the ability to diagnose bacteriologic, viral, and parasitologic diseases in real time. The lab and the epidemiologists and clinicians it supports have set a new standard for operational medicine. No longer is it acceptable for retrospective

assessments to tell what happened. Now we can tell what is happening.

In early January the U.S. Army's 86th Evacuation Hospital deployed, placing an echelon III capability in country for the first time. The unit out of Fort Campbell, Kentucky, arrived with its own equipment, the first time an evacuation hospital has been flown into deployment. By 10 Jan 1993, the medical deployment was complete and the Army began taking over responsibility from the Navy.

At the same time, the first Swedish field hospital arrived to provide similar echelon III care for coalition forces. Deployment of these very capable facilities made the environment for the increasing coalition and U.S. forces medically secure.

A special word has to be said for the Air Force strategic medevac system. On the ground early with coordinators and a medical aeromedical staging facility, and an air transportable hospital on the airfield in Cairo, the Air Force was flawless in providing medical evacuation out of the country.

Humanitarian Operations

The mission of U.S. forces in Somalia was to support the troops, not to deliver health care to the general popu-

lation. There were sufficient civilian medical assets already in country that just couldn't work. American personnel wanted to help in any way possible, but the traditional MEDCAP operation so effective in the past was potentially counterproductive in Somalia. Instead, a program was set up to help the ICRC, Red Crescent, and the humanitarian relief agencies with their programs. Medical assistance programs were authorized only when they fulfilled the following criteria. Programs had to:

- recognize and respect Somali culture,
- work through the existing medical establishment, and
- leave something of value behind when American forces left.

American and coalition forces began creating programs to help the humanitarian relief agencies and Somalis through existing organizations. The ICRC, Red Crescent, and other relief organizations were canvassed to determine their needs. Our assistance was funneled through them to meet their requirements. Our medical repair personnel worked on hospital equipment, and doctors gave lectures or taught techniques for anesthesia or pain control.

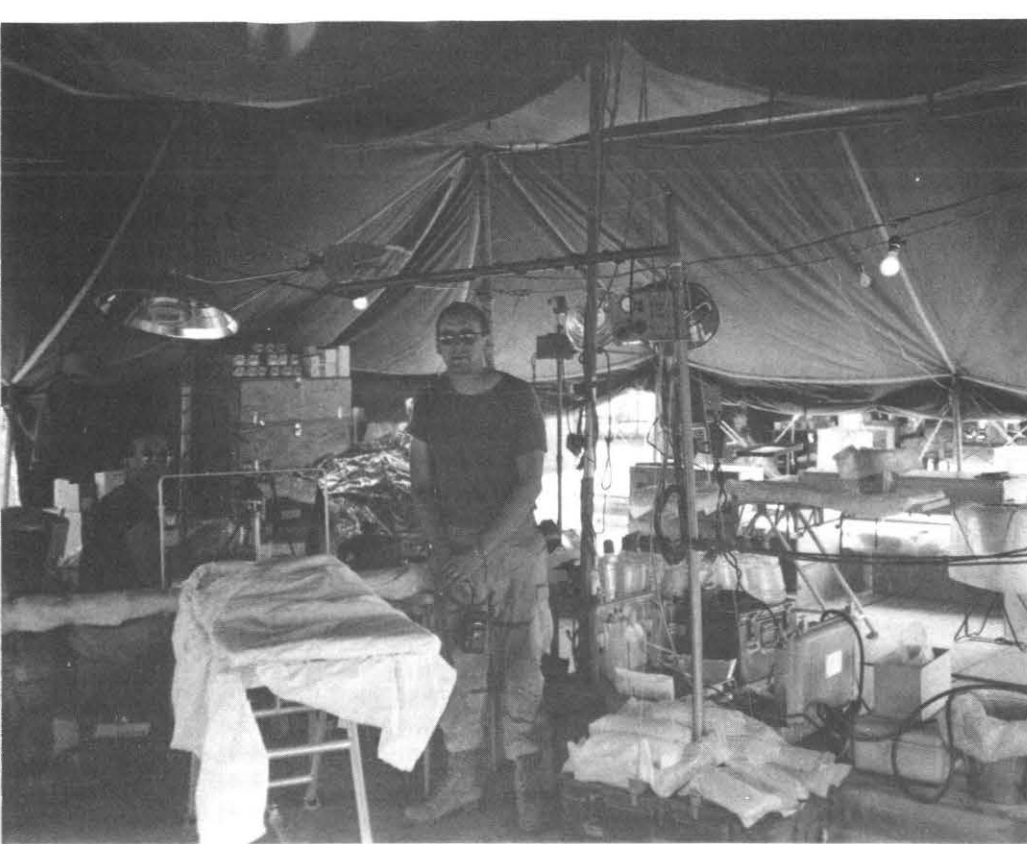
There is a biblical proverb about how much better it is to teach a man to fish than to give him a fish. That concept was the basis for our MEDCAPs. The work accomplished by American medical personnel will improve the health care of Somalis for some time by improving the medical care infrastructure.

Lessons Learned

Some aspects of this operation may serve as models for future humanitarian interventions in third world countries. If so, what have we learned?

These so-called "technicals" were used by roving gangs to intimidate the populace and other gangs. The metal "cowcatcher" enabled the driver to run down his victims without damaging the vehicle's radiator.





Infectious disease specialist, CDR Mark Wallace, MC, in the OR tent of the collecting and clearing company.

Operation Restore Hope shows that Americans are willing to spend significant national resources to aid the helpless citizens of a land few could even find on a map. It showed how quickly we can safely and professionally bring together all the armed forces and project a strong presence on a distant shore. I saw the moral quality of young marines facing imminent danger show restraint, compassion, and understanding. We have nothing to gain materially in Somalia, so our help there is the highest order of humanitarian service.

We could have done some things better. All the plans weren't ready when the troops were. Many of my staff met each other on the way over. Joint planning and operations is the future, and we need to practice how we will play.

The hospital ship was not deployed but would have been very valuable. It would have eliminated the danger of the long medevac legs, removed the big footprint of shore-based hospitals, and eased the logistics burden of bringing in an evacuation hospital.

The staff of the collecting and clearing company worked heroically to keep their 1993 medical equipment functional in 1853 style tentage. The weather was just too much for the

tents. It was too hot and windy. Without *Tripoli's* operating rooms in the area, dirty surgeries would have been inevitable.

The long intra-theater medevac legs required the dedication of USMC helicopters to ensure that critical patients would be transported urgently. The morale factor of safe (on-time-every-time) medevacs is hard to measure but not hard to see. USMC medevac doctrine may need to be revisited in light of this experience.

Navy medicine is very good at providing organic medical support, but needs to develop a new doctrine for humanitarian (MEDCAP) support of indigenous people. Old Vietnam era "win the hearts and minds" concepts of doling out a little medical care on a Saturday afternoon at the local village doesn't cut it. MEDCAPs are useful occupational therapy for doctors, but don't help the recipients enough to compensate for the potential dangers to both doctors and missions. There are ways to help, but they take a bigger commitment. We should learn how to do it.

The Future

The transfer of responsibility for Somalia has begun. The U.N. is in the process of deciding how it will con-

tinue the peacekeeping missions begun by the United States. U.S. forces have begun pulling out and U.N. forces are slowly taking over.

What does the future hold for Somalia? Will all this effort do any good? I have no crystal ball but I saw the beginnings of change. The voiceless (those who did not have their own personal crew-served weapon) have already begun to find their voices again. I saw policemen put on their old uniforms and return to the streets to direct traffic without payment. Schoolteachers are also working without pay to reopen their classes. A soccer game was held in a public stadium without anyone being shot. These perhaps are little steps but progress nevertheless.

The head physician for Keysani Hospital said that she could see "life returning to Somalia." People are in the streets going about the business of their lives.

Recent demonstrations in Mogadishu seemed to suggest that things were getting worse. But demonstrations indicate that Somalis care, think there is hope for a future, and assume there is an audience which also cares about their problems. A few months ago anyone foolhardy enough to demonstrate would have been gunned down by any opposition with no world attention. Now they have the chance to air their grievances.

So the process is working, haltingly, imperfectly, and sometimes at odds, but working. If peace can be maintained, Somalia will soon be a nation again.

Navy medicine has been an important part of this process and we can be proud of what the United States is trying to do. If Somalia is a "lab" for the future of littoral "From the Sea" operations, the future is bright. We can do this. □

—Story and photos by CAPT Michael L. Cowan, MC, Force Medical Officer, Commander, Naval Surface Force, Pacific Fleet, San Diego, CA.

Reserve Readiness Researcher Studies NRRC Detroit

LCDR Avery B. Loucks, USNR

It's hard to fight a war with a toothache! Finding out how many potential toothaches and other medical ailments that would "ground" reservists is the job of CAPT Arnold Pock, MSC, USNR. His reserve readiness assessment assignment was based on needs discovered during the Gulf War.

One of his stops in this research project brought him to Naval Reserve Readiness Center (NRRC) Detroit, in Southfield, MI. Detroit was one of six centers in six readiness commands nationwide chosen for the study. NRRC Detroit had over 200 reservists activated for Operations Desert Shield/Storm.

CAPT Pock observed that "As an aftermath of Operation Desert Storm, we discovered significant problems in dental and medical readiness. Although many Navy men and women did have current physical and dental examinations at call-up, some health problems surfaced." In sailor's terms, they probably were not medically or dentally ready to "fight the ship" or "fly the plane." A more comprehensive physical and dental examination may have prevented these problems.

While the actual performance of activated reservists in the Gulf was rated outstanding, the war was short and the Reserve components had plenty of time (3 weeks) to get ready. The Reserve Matters branch of the Bureau of Medicine and Surgery wants to determine if drilling citizen/sailors could handle a long war that started very quickly and without benefit of predeployment examinations and treatment.

CAPT Pock was aided by active duty and reserve Medical Department members organized by HMI Timothy

Gavin for what CAPT Pock calls a "stubby pencil process . . . getting down to actual entries in physical and dental records . . . We would look at every single record." CAPT Pock is on a 4-year recall program as Head, Total Force Reserve Services, BUMED. He and his team members, under RADM Robert Nuss, MC, USNR, and RADM James Yeargin, DC, USNR, are responsible for implementation of this medical/dental readiness assessment project. The project began last September and the statistics assembled will enable the Reserve components to ascertain their medical and dental readiness and determine if refinements are needed to upgrade overall health readiness standards.

According to CAPT Pock, "Our concerns are that if we send people without comprehensive physicals or in a dental class three status (with oral pathology) to contingency sites, problems may arise which can lead to disability. Problems such as a toothache can result in a mission abort. The whole idea of these examinations (dental and physical) is to assess the physical readiness for mobilization of the reservist, and unless that reservist gets a thorough dental and physical exam we are not accomplishing our goal of health readiness. We are leaving the door open for medical shortfalls during a contingency." Pock also pointed out that statistics from each of the pilot study sites will be reported to the Commander, Naval Reserve Force, (Medical) in New Orleans by 5 Oct 1993. Thereafter, decisions regarding any changes in the physical and dental examination process will be considered.

Regulations require members of the Reserve to maintain their own health

at mobilization health standards in order to remain in the Reserve program. CAPT Pock added, "If a Navy physical, for example, indicates a hernia or a dental problem, it's the responsibility of the reservist to get those things fixed."

The solution? Pock prefers to wait for the pilot study results before predicting any followup action. "Higher authority will make that call." He also indicated that it would be nice to have medical and dental examinations as part of the unit training readiness ratings in order to obtain greater compliance to treatment recommendations and the fulfillment of ongoing medical/dental examinations. This action would place medical and dental concerns at parity with training, and would ultimately enhance total individual readiness. Unit CO's truly want to "care for their people" and we need to assist them every way possible.

"Unless we use some similar vehicle to monitor our Reserve health status, we will always have incomplete information regarding the mobilization potential of our Reserve components.

"The health readiness issues which surfaced during Operations Desert Shield/Storm could lead to wartime toothaches and medical concerns haunting us again. The luxury of 3 weeks processing time may not always be available in future conflicts," CAPT Pock continued.

"The enthusiasm for this project at our center was overwhelming," said CAPT Shirley J. Thomas, CO of NRRC Detroit. "This project may very well lead to giving our nation a healthier and better trained naval reservist." □

LCDR Loucks is a member of the Office of Information Det. 206, Washington, DC.

A Doctor Remembers Somalia

Because they deal regularly with trauma and tragedy, doctors will tell you that professional detachment is essential to the job. Yet even the most case-hardened will also admit to occasions when this psychic shield gives way, when the sheer drama and emotion of a moment bring another's suffering painfully home. For Navy physician Curt Andersen, recently returned from Somalia, one such moment stands as perhaps his most vivid memory of that stricken country—a place and people that in just a few eventful weeks he grew to love as well as pity.

A gentle-natured 32-year-old with thin blond hair and wire-frame glasses, LT Andersen, a native of Fresno, CA, practices primary care at Alameda Naval Air Station's medical clinic. When called to Somalia in December as part of a support detachment for the Marines, he—like thousands of mobilized servicemen and women—had little idea what to expect in Operation Restore Hope. The one certainty was that he would miss Christmas with his wife and two young children. After a crash course in survival skills, including the use of a 9-millimeter automatic pistol he was to carry with him at all times (he had no experience with guns), Andersen arrived in the port city of Mogadishu on Christmas Day.

Securing the port has been the Marines' first priority, and it was there that Andersen's unit (part of the 1st Fleet Service Support Group, or 1st FSSG, set up shop—or rather, tents. The Group Aid Station, as it was called, consisted of a clinic and trauma room. Protected by a fence and Marine sentries, the compound was relatively secure, if hardly ideal.

"Our facility was right next to this warehouse, where most Americans lived," Andersen recalls. "When the Marines first arrived the warehouse was literally knee deep in fecal matter, dead goats, bats, rats, even a couple of human bodies. They went in with a fire hose and hosed it all out, washed it out onto the pier. Every day I used to think about breathing in all that dust blowing in the air."

They did not have to wait long for customers. On their second day an MP came running in carrying a Somali man who had been accidentally crushed by the front gate as a truck came through. The man was limp and barely breathing. "We ran a code on him," Andersen says (a set of emergency procedures to stabilize him). "After a while we could see he wasn't going to make it. But we just kept on going. We decided he better not die at our facility. We didn't know how the Somali people would react. We were afraid they might riot against us or something."

They decided the man had to be moved out of the compound. "So under heavy, heavy Marine guard—this was early in the campaign, it was at night and we had to go over the green line into what was considered the war zone—we drove him to a Somali hospital."

Conditions at the hospital shocked Andersen. "The hospital's trauma room consisted of a table, a trash can, and a light. That was it." Andersen and his colleagues consulted with an Egyptian doctor, and together they pronounced the man dead. "The hospital was unbelievable. There was human feces on the floor, kids running around without diapers on, excreting all over the place." He describes a ward devoted to victims of tetanus, a disease rarely seen now in the United States. "It's really an agonizing disease, and to see people suffering like that. . . ."

There were few, if any, Somali doctors, adds Andersen, because virtually everyone with education or money had fled the country during the civil war. Basic medical supplies were scarce or nonexistent, and hospitals did not escape the pervasive looting that had stripped buildings of most anything of value that could be moved. "There was no law, no government at all in Somalia," says Andersen. "The situation was basically chaotic."

He recalls the tension of driving through danger zones, ducking at the staccato bursts of gunfire while grasping his pistol. On one occasion the shots were so close he could smell the powder. One of his Marine escorts yelled out, "I'm hit!" (It turned out that in the excitement the marine had accidentally shot himself in the leg.) Andersen had to administer to the wound in the middle of a firefight.

With the growing military presence the danger subsided somewhat—though few days seemed to pass without the sound of rifle shots (and sometimes mortar fire) ringing somewhere in the distance. As tensions eased Andersen was determined to get to know more of the country and its people. He quickly picked up the basics of the language, delighting in starting conversations with surprised natives. He hitched a ride on a plane dropping leaflets over the countryside that called for gunmen to turn in their weapons. He traveled inland to Baidoa and down the coast to Kismaayo, met U.N. relief workers, soldiers, and journalists from around the world, as well as Somali refugees from different parts of the country.

Andersen also treated hundreds of Somalis through a program called MEDCAP (Medical Civic Action Program), in which military medical personnel set up temporary clinics in Mogadishu and surrounding villages. In

doing so he made many friends among the Somalis, most of whom were genuinely grateful to have the Americans there, and many of whom seemed especially to like Andersen himself.

Part of his popularity no doubt stemmed from a tendency to give out advice and treatment on his own time to almost anyone who asked for it. "Dr. Andersen" became a well-known name around Mogadishu. In exchange for his administrations he subjected his patients to a barrage of friendly inquiries, in faltering Somali, about their culture and beliefs.

One Somali friend was only too eager to teach him the ways of Islam (Somalia is predominately Muslim). When Andersen had repeated a chant satisfactorily, his friend pronounced him a Muslim. "He said I would need to have a new name," recounts Andersen. "'Why's that?' I asked. He said that usually everyone is named for the prophet, Mohammed. He asked me my father's name. 'Ralph,' I told him. 'OK,' he said, 'from now on you are Mohammed Ralph.'"

Near the end of his stay another Somali friend beseeched him to remain. "'We need you, Dr. Andersen,' he said. 'Stay with us.'" The man offered Andersen land and a farm by the river. When Andersen told him he had a wife and children in America, the man said, "I will give you two wives." Andersen respectfully declined, and the man raised the offer to four wives.

Andersen was grateful for the chance to treat some of the myriad sick and injured Somalis. But his primary responsibility was the health of the 24,000 U.S. servicemen and women (as well as coalition forces and U.S. civilians) deployed in a sweltering, war-ravaged tropical country with poor to no sanitation. From malaria and dengue fever to diarrhea, heat stroke and sunburn—along with the many injuries from accidents, thrown rocks, and the occasional gun battle—Dr. Andersen and his colleagues had no shortage of regular work. In fact, though it initially consisted of just two doctors and a handful of corpsmen, the Group Aid Station proved to be the busiest medical facility in the country.

"Early in the mission we saw about 40-60 patients a day; over 1,500 during the time I was there." In contrast, the much better equipped and staffed Medical Battalion field hospital, located at the U.S. Embassy compound several miles from the port, saw a fraction of that number. "They got the most serious cases," Andersen explains. "The ones requiring specialized care—surgery and so forth."

Still, it was his MEDCAP work that Andersen found most rewarding. It was also heartbreaking and frustrating. "You'd be out there for 3 hours, and you'd come back completely exhausted, drained. From just seeing so many problems, so many heartbreaking things: children dying of tuberculosis and other diseases, gunshot wounds, limb-threatening conditions, just so much. But you would also feel like you really contributed."

Andersen recalls going to a Somali pediatric hospital to

treat a boy of nine who had been beaten. "Again, the conditions were appalling, by our standards. But there were kids everywhere, and they were so excited to see an American, they just mobbed me. They wanted to touch me, hold my hand, shake my hand. And when I started speaking to them in Somali, asking them their names and ages, they just went wild." Andersen smiles. "That made me feel like everything was worth it, that this is why we're here."

Andersen and his colleagues knew they could treat only a tiny fraction of the thousands of Somalis desperately in need of attention for infected wounds, dysentery, malaria, malnutrition, tuberculosis, and a host of other serious ailments. And even many of those he saw he could not help because of a limited supply of medicines and equipment. Indeed, the fear that the MEDCAP's would deplete resources needed for U.S. personnel prompted most among the military brass to oppose them in Somalia's case. Andersen's commander was one of a very few to give the go-ahead.

Again and again Andersen found himself deeply touched and disturbed by the plight of the Somalis. He remembers a woman's account of being robbed by marauding gunmen of the precious food she'd managed to procure at market, a man's story of being bound and forced to watch thugs rape his wife and daughters, and of parents telling how they could only sit by helplessly as their children slowly starved to death.

But there was one incident, occurring just a few days before he was to return to the States, which affected him like no other.

"We got a call that someone had been shot at the front gate. I was the only doctor there at the time; the other doctors were out on a MEDCAP. I jumped into the truck and drove out with some marines. The victim was a boy, perhaps 17, with a fatal bullet wound through the head.

"There was a crowd gathering, a lot of arguing going on over who shot him—whether it was one of the Arab Security Forces, or another Somali, or a U.S. Marine. After I pronounced him dead I looked into the crowd for some reason, and there was this man trying to get through.

"Somehow I knew the man was the boy's father. I told them to let him through and I brought him over to the boy, who was lying on this wooden wheelbarrow they'd brought him over on. When he saw it was his son the man started to weep. He wasn't crying hysterically, he was just . . . weeping. His face was so hard, so rugged. And then I just . . . I felt so bad at that moment. It hit me how awful this was. A few years ago my brother was killed in an accident, from massive head trauma like this boy. I'd seen my own father, known what we'd been through. And it all came flooding back to me in that instant."

It was Friday, the Muslim Sabbath, and the father wanted to take the boy and bury him quickly according to Somali custom. The Marine investigators, on the other hand, were equally determined to take the body to be autopsied.

"It was really a tense moment. I took the father aside, took an Army interpreter, and I started to tell him how bad I felt for him, how something like this had happened in my own family. And then I started to choke up. I told him that we wanted to find out who did this. I promised him the boy wouldn't be carved up, and we'd get his son's body back to him that day."

Well aware of military procedure and bureaucracy, Andersen knew what he would be up against in trying to keep that promise. But he was determined. "We got an ambulance, took the father and his brother and the interpreter, and drove the boy to the Army hospital." They managed to find the pathologist and get him to come outside to examine the body. "He didn't even take him into the hospital. Without cutting into him he basically determined the shot came from an AK-47, not an M-16. So more than likely it was another Somali who shot him."

Finally they drove the boy, his father, and brother back to the green line—the edge of the war zone. "It was as far as we could go," explains Andersen. From there the father and the brother carried the boy away.

The incident represented a low point for Andersen, he says. "At that point I just had this overwhelming sense of dashed hopes. I wondered whether all our efforts were in vain."

What does he think now? Has the United States and coalition effort ultimately helped Somalia? "Oh, definitely. It's definitely helped. When I left people were no longer dying from starvation—in fact, the feeding centers were starting to scale down. And school had started again, after 2½ years when there was no school. . . .

"But as far as a long-term solution, I just don't know how they're going to straighten it out. There are so many different factions, and they all want power and boundaries . . . it's just one clan against another against another, with no government. And there's a whole generation of young men who for the past 5 years have made their living from toting around AK-47's. It's going to be hard to change that mentality." □

—Story by Robert Figueroa, Public Affairs Office, Naval Hospital, Oakland, CA.

Deck Log of USS *Sanctuary* (AH-17) 1 Jan 1970

Wunder Beach Op Area, South China Sea

The dawn of a new year in the South China Sea
Finds *Sanctuary* on station steaming independently.
Sister *Repose* is enjoying a break from the rigor
Soon to return with recharged vigor.

For COMSEVENTHFLT we patrol Wunder Beach
Awaiting medevac choppers—we're always in reach.
We begin quarter three of this fiscal year
That makes 3 years that we've been here.

The size of our op area requires a slow ride
It's 6 miles long, 2.5 miles wide.
Steering one-three-zero south and three-one-zero north
To remain in this area we maneuver back and forth.

North 16 degrees—47.2 minutes
One-oh-seven-twenty-four point eight east from
Greenwich.
This is the center of the area in terms quite precise
One more winter we won't worry about ice.

The flares on the beach are signs of the war
But our mission of mercy requires Condition IV.
The ship is buttoned up, the watch reports "All secure."
Material condition "YOKE" is set to be sure.

Our navigation and hospital ship lights are bright
To a Vietnamese fisherman we must be a sight.

Our helo beacon will flash 'til the first light of day
"You find 'em, we bind 'em" is what we say.

The helo watch is set; the patient handlers are ready
Even though the flow of casualties is no longer steady.
We have many empty beds and that's a good sign
But one never knows when he'll hit Charlie's mine.

It may very well be another fog-bound day
When we can't see the shore just a mile away.
But the medevac pilots are a very brave breed
Never hesitating to fly when a buddy's in need.

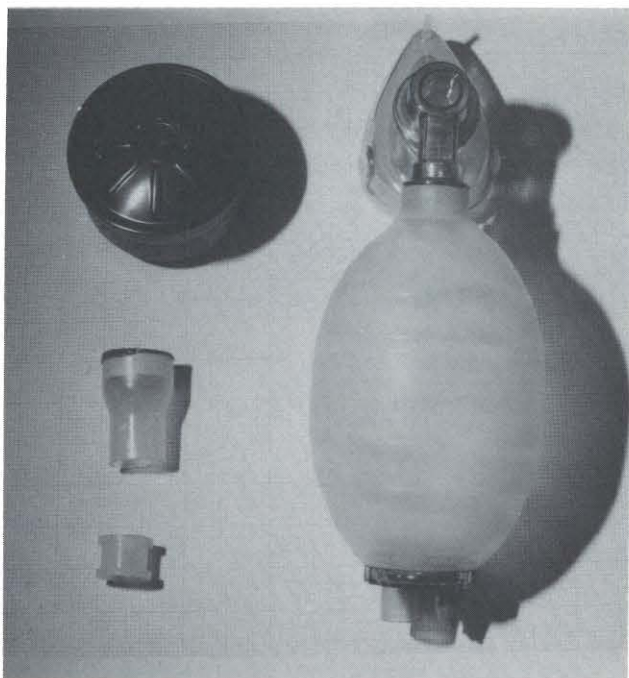
Tonite a light breeze blows out from the shore
And the monsoon sky lingers over I Corps.
The seas get calmer day by day
That means Tet's not too far away.

A VAROOM! from the shore reports through the night
Recalling that day we decided to fight.
In a land that for decades has known little peace
We're doing our part while praying the battle will cease.

In the new year we hope to see the Golden Gate
Surely we can move to alter this fate.
Perhaps Hanoi will join in this one resolution
"Stop the fighting and find a solution."

ENS C.S. McDowell, USNR

Mechanical Ventilation of Apneic Nerve Agent Casualties



Field CBR AMBU components

A Navy corpsman is always looking for a way to improve an item. After reading the article on nerve agent casualties in *Navy Medicine* September-October 1992, I realized the SEAL corpsman needs to have a standby method as well. I took the AMAL 0972 SPECWAR HM loadout, and came up with an idea much like your article suggested but used the C-2 filter. The C-2 filter is used in the shipboard environment with the MCU2-P mask and in field operations with the M-40 mask.

Our solution was using only AMAL 0972 items: NSN 6515-01-061-7812 AMBU, NSN 6515-01-289-9839 case, 60 cc syringe, and the NSN 4240-21-871-7842 C-2 filter to make an impromptu CBR AMBU bag.

Take the plastic case that holds the 60 cc syringe and cut approximately 2½ inches down from the bell-shaped top. Line the inside of the bell-shaped plastic top with waterproof tape and screw it onto the C-2 filter threads. Take the dome bushing out of the child mask



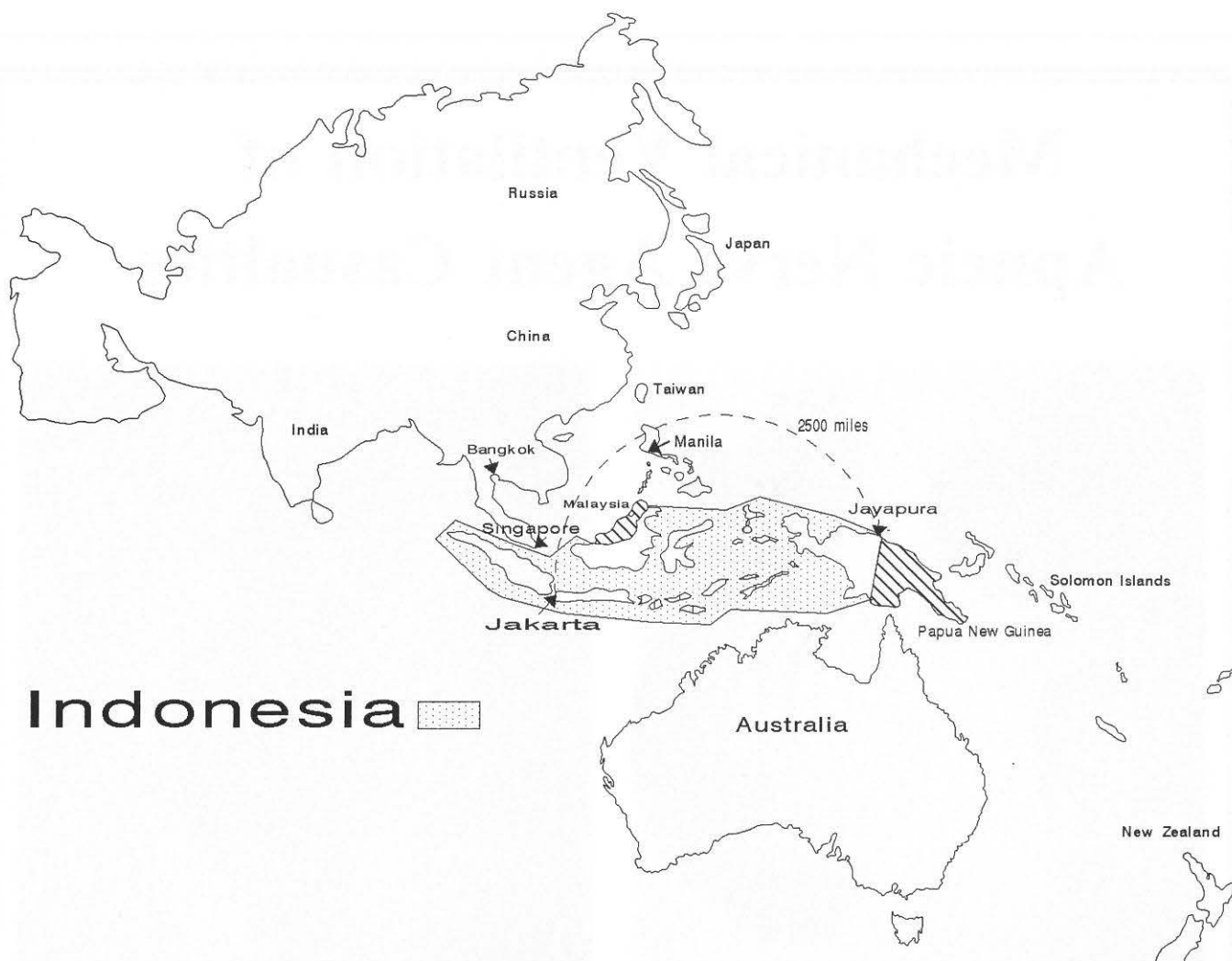
Assembled equipment

and place it on the ventilation bag reservoir intake. Place the plastic syringe case over the dome bushing. Seal the oxygen nipple closed with waterproof tape.

The SEAL corpsman now has a field expedient means to deliver filtered, positive pressure ventilation to a CBR casualty in a contaminated environment using his AMAL.

I am sure that this idea can be improved upon, and maybe it is time someone developed a better CBR AMBU bag.

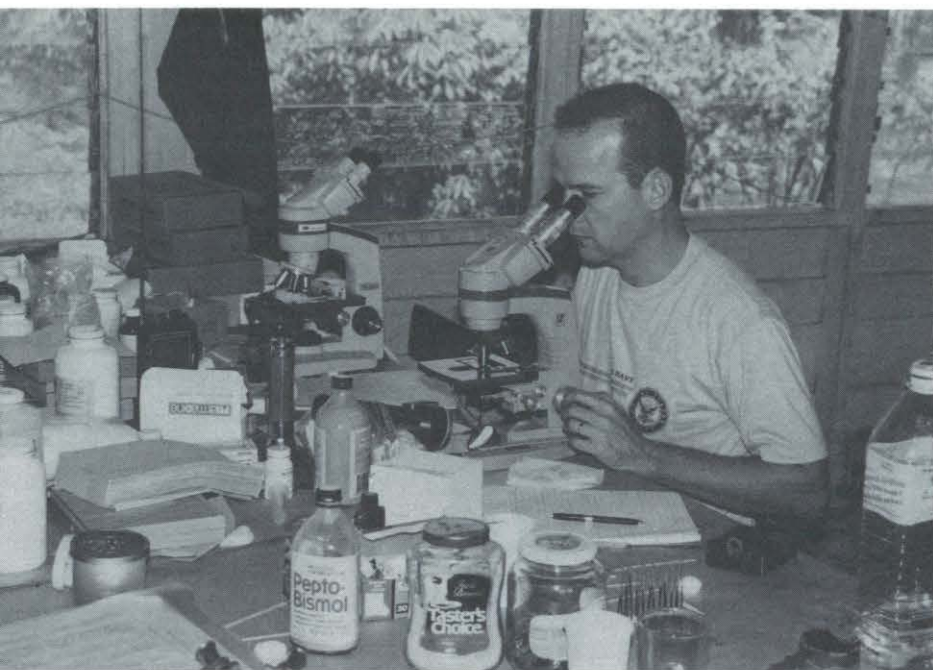
—Story and photos by HMCS Steven G. Shunk, SEAL Team Eight, Norfolk, VA.



Indonesia 

People from Java now exposed to heavy malaria transmission in Arso PIR, Irian Jaya.





LCDR Trevor Jones examining blood films for malaria parasites in the field laboratory.

Malaria Field Studies at NAMRU-2, Indonesia

LCDR J. Kevin Baird, MSC, USN
LCDR Trevor R. Jones, MSC, USN
LT Michael J. Bangs, MSC, USN
LCDR Thomas L. Richie, MC, USNR
CAPT Stephen L. Hoffman, MC, USN

The Malaria Threat

Malaria infects over 200 million people each year and over 1 million of these people die.⁽¹⁾ The morbidity and mortality caused by malaria is a staggering public health problem throughout much of the tropics. Despite the great strides in biology and medicine made in the past 30 years, the malaria situation has dramatically deteriorated since 1960.⁽¹⁾

Malaria eradication seemed possible during the 1950's with the advent of inexpensive and effective new anti-malarial agents like chloroquine and

new insecticides such as DDT. Indeed, malaria was eradicated from the temperate zones of North America, Europe, Australia, Japan, Taiwan, and many smaller islands. However, due to biological resistance to anti-malarials and insecticides, crippling logistical and economic difficulties, and, most importantly, because of the intense transmission of malaria in some parts of the world, the malaria parasite remains a well-entrenched adversary.

The development of resistance to chloroquine by *Plasmodium falcip-*

arum in particular has contributed to the worsening malaria situation. Chloroquine is a four-aminoquinoline drug which kills the asexual blood stages of all four species of the malaria parasite which naturally infect man. The drug was developed in Germany in the 1930's and was undergoing clinical trials in North Africa in 1943 when Allied troops arrived and seized the experimental tablets. The U.S. Army further developed chloroquine and by 1946 it had become the drug of choice for treatment of malaria. During the next 15 years, the malaria parasite was

LCDR Kevin Baird conducting in vitro tests of drug resistance against malaria parasites in the field laboratory in Arso PIR.

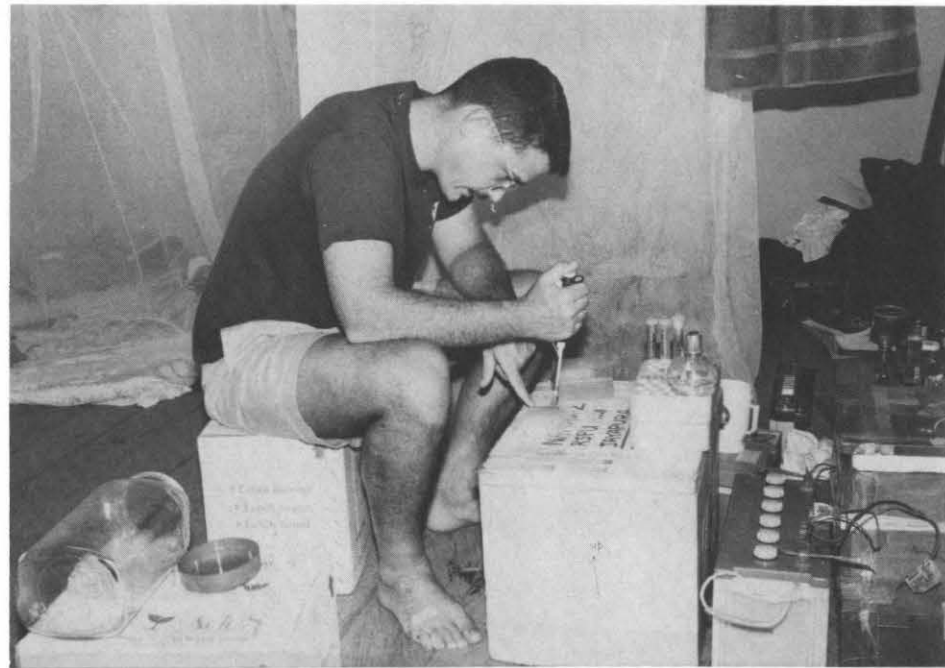
consistently sensitive to this safe and very inexpensive drug.

Chloroquine became the first line of defense against malaria throughout the world, being available to even poor people living in very remote areas. Today, these are the very people most affected by the development of resistance to chloroquine. From their perspective, alternative therapies against chloroquine-resistant strains of *P. falciparum* are neither available nor affordable. The global predominance of chloroquine-resistant strains of *P. falciparum* is perhaps the single-most important factor contributing to the global trend of greater morbidity and mortality caused by malaria.

Resistance to chloroquine by *P. falciparum* was first detected around 1960 in Colombia and Thailand. Today, chloroquine-resistant strains of this parasite occur wherever there is malaria, except in Central America, the Caribbean, and parts of the Middle East.(2) Recent reports have demonstrated the appearance of chloroquine-resistant *P. vivax* in Indonesia and Papua New Guinea.(3-6)

Newer antimalarials, such as mefloquine, have initially proven effective against chloroquine-resistant parasites. However, after just 3 years of mefloquine use in Thailand, resistance to the drug by *P. falciparum* became very common. Today, mefloquine is usually ineffective along the Thai-Cambodian border. Mefloquine was developed by the U.S. Army through a process requiring nearly 20 years and millions of dollars. Halofantrine, another Army research product, is effective against chloroquine-resistant *P. falciparum*, but seems less effective against mefloquine-resistant parasites.

Development of antimalarial drugs is very costly, technically difficult, and offers relatively little potential for return upon capital investment. As a



result, there are precious few new antimalarial drug candidates. The slow, costly development of new antimalarials seems incapable of keeping pace of the development of resistance by the parasite. It seems highly unlikely that insecticides and antimalarial drugs alone could indefinitely sustain effective measures of malaria control, and almost certainly not malaria eradication. A malaria vaccine is needed to help gain control over the global malaria situation and eventually eradicate this scourge.



Military Relevance of Malaria

Military forces operating in areas where malaria is endemic, risk incapacitating outbreaks of infection. In all wars fought in the tropics and subtropics, malaria caused more lost man-days than enemy bullets and bombs. Sir William Slim, Field Marshal of British forces in Burma during World War II noted that, "In 1943, for every man evacuated with wounds we had one hundred and twenty evacuated sick. The annual malaria rate alone was 84% per annum of the total strength of the army and still higher among the forward troops."(7) Beadle and Hoffman (1992)(8) have reviewed malaria in U.S. naval forces deployed

to theaters of war during this century: malaria caused 90 deaths and over 3 million lost man-days among 114,000 infections of naval personnel between 1941 and 1945.(8) Attack rates were five to ten times higher early in World War II because officers of the line did not yet appreciate the danger of malaria.(8)

Control of malaria in a theater of war requires aggressive preventive measures which demand the attention and effort of line commanders. Nonetheless, in the face of immediate tactical demands the best efforts sometimes prove impossible and malaria among forward troops may be inevitable. This was the experience among many Marine rifle companies during hostilities in Korea and Vietnam. Marines in the field might lose their supply of antimalarial agents, the supply may be damaged or not arrive at all, Marines may forget to take the antimalarials, the only drug available may make some people sick, the command may fail to regularly enforce consumption of antimalarials, or the parasite might resist standard prophylaxis and therapy. All these factors, and many more, contribute to the occurrence of malaria among military personnel deployed to the tropics.



 Chloroquine sensitive
 Chloroquine resistant

A sailor or marine infected by malaria parasites will become disabled for a week or more. In the worst case, infection by *P. falciparum* may progress to death with surprising swiftness. The patient must be hospitalized and carefully managed. This is especially true given the mosaic nature of the patterns of resistance to antimalarials around the globe. The best therapeutic regimen depends very much upon where the infection was acquired. Often, the drug resistance situation changes dramatically not only within regions and nations, but even within a single province or island. For example, in the province of Irian Jaya in eastern Indonesia, high-grade resistance to chloroquine is common in the northeastern region,(4,9) but appears to be low-grade and relatively rare in the central southern coastal region. Where this sort of information is incomplete, which is almost everywhere, prevention and treatment of



NAMRU-2's field physician, Hasan Basri, provides a wide range of medical services for residents of Arso PIR.

A NAMRU-2 employee, Maman Supriatman, drawing blood for immunologic studies.

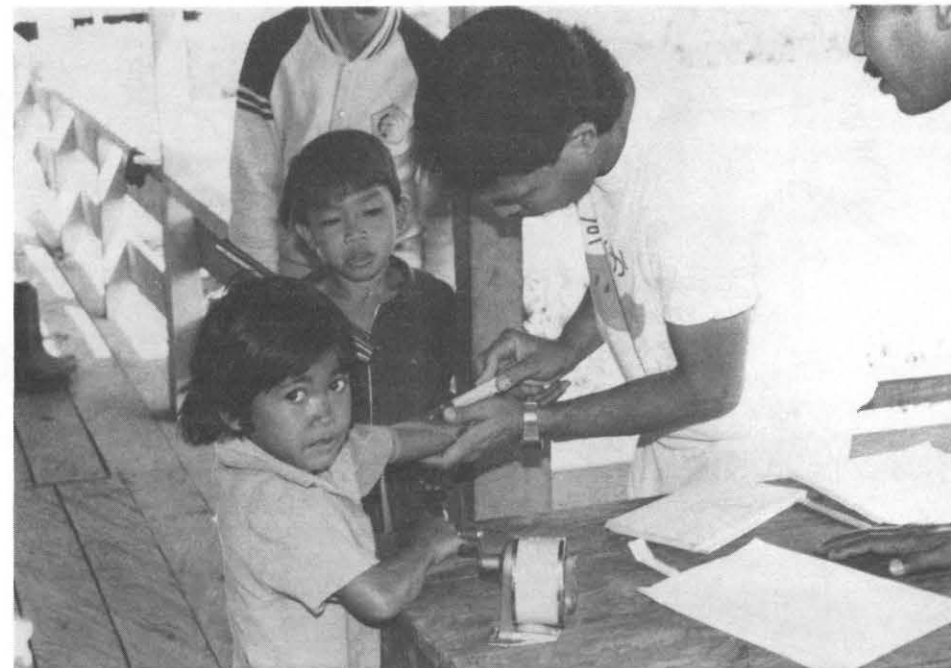
malaria may at first entail no small degree of trial and error at a cost of diminished operational readiness.

An efficacious vaccine against malaria administered to military personnel prior to their deployment to an endemic area may obviate the tactical, logistical, and medical difficulties of malaria prevention and treatment in a theater of military operations. This is why malaria vaccine development is an important medical research and development objective within DOD. However, there will not be a deployable malaria vaccine available for a number of years and the DOD medical research community must continue work toward improving conventional methods of malaria prevention and treatment.

NAMRU-2

The U.S. Naval Medical Research Unit No. 2 (NAMRU-2) is located in Jakarta on the northwest coast of the island of Java in the Republic of Indonesia. Jakarta is a modern cosmopolitan city of about 10 million people. Indonesia's 13,667 islands straddle the equator over a distance of 5,400 kilometers between the Pacific and Indian Oceans. Many of these islands are visions of lush tropical loveliness, but the archipelago also presents a rich diversity of infectious diseases common in tropical environments, including malaria, filariasis, intestinal helminths and protozoa, dengue fever, Japanese encephalitis, cholera, and typhoid fever. NAMRU-2 pursues hospital, field, and laboratory-based studies of most of these diseases.

NAMRU-2 is hosted by the Indonesian Ministry of Health. The laboratory is located on the grounds of the Indonesian National Institutes of Health in central Jakarta. The laboratory consists of departments of microbiology, immunology, parasitology, virology, entomology, and clinical medicine. The American staff consists



of the commanding officer, administrative officer, comptroller, two administrative chiefs, two civilian contract scientists, eight Navy physicians, microbiologists, parasitologists, immunologists, entomologists, epidemiologists, a U.S. Army veterinarian/virologist, and three hospital corpsmen.

The backbone of the laboratory is the permanent staff of 90 Indonesian nationals, many of whom have been on board since NAMRU-2 opened in 1970. The Indonesian staff includes physicians, scientists, laboratory and field technicians, secretaries, accountants, electricians, drivers, and janitors. All studies at NAMRU-2 are conducted in collaboration with Indonesian counterparts in the Ministry of Health at the local and national level, and with many Indonesian universities.

Malaria Research Objectives at NAMRU-2

Malaria research at NAMRU-2 is guided by the formal research priorities and objectives of the Naval Medical Research and Development Command in Bethesda, MD. A very close working relationship with the Malaria Program at the Naval

Medical Research Institute (NMRI) in Bethesda also lends direction to NAMRU-2 malaria research. Moreover, malaria investigators at NAMRU-2 and NMRI collaborate and coordinate specific research objectives with U.S. Army counterparts in Washington, Bangkok, and Nairobi. A team spirit is very much in evidence within the Army and Navy malaria research programs.

Each overseas DOD laboratory, including NAMRU-2, strives to support the malaria vaccine development strategies pursued by the more advanced Stateside DOD laboratories. In addition, the overseas labs pursue a variety of field studies intended to improve conventional methods of malaria threat assessment, control, prevention, and treatment. Malaria research at NAMRU-2 is directed toward twin objectives: (1) support of malaria vaccine development for the future, and (2) improvement of conventional antimalaria measures for the present.

Malaria Field Activities at NAMRU-2

Malaria transmission does not occur in Jakarta, where NAMRU-2 is located. However, except for the

islands of Bali and Java, malaria is endemic on most of the major islands of Indonesia. Perhaps the most severe malaria problem in Indonesia occurs in Irian Jaya,(10) the eastern-most province of Indonesia abutting Papua New Guinea. This is where many of the malaria research efforts of NAMRU-2 have been focused since 1982.

In several important respects, Irian Jaya is an ideal site for malaria studies directed toward the twin objectives of supporting vaccine development and improving conventional ways to prevent and treat infection. Irian Jaya is a sparsely populated frontier province. The government of Indonesia encourages the transmigration of families from the crowded islands of Java and Bali to Irian Jaya. The government provides incentives of free land, housing, implements, and food supplements. From the research perspective, malaria among these people, who lack acquired immunity to malaria upon arrival, is representative of malaria which might occur among American troops deployed to an endemic area.

NAMRU-2 built a permanent modern laboratory in the city of Jayapura, the provincial capital of Irian Jaya, as a base of operations and laboratory

support for studies in areas of new settlements. The laboratory is located on the grounds of the provincial hospital where a number of clinical and laboratory malaria research projects have been done.(11-14)

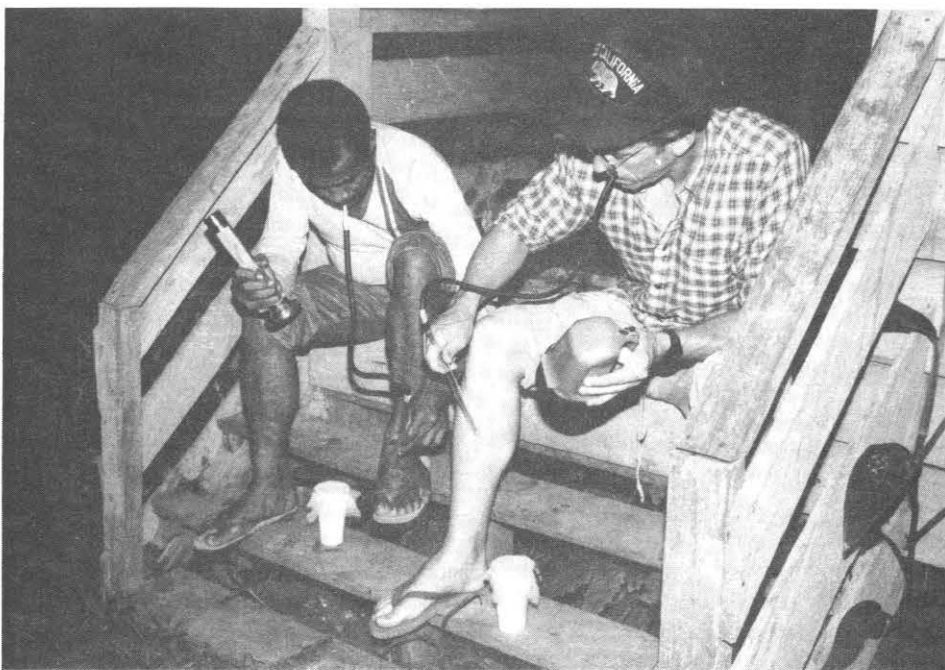
Village-Based Studies. NAMRU-2 has worked extensively in the Arso region, which is 2 hours by car to the southeast of Jayapura, near the border with Papua New Guinea. There are many transmigration communities in Arso. The Arso region lies at the southern extreme of a narrow, swampy coastal plain. Despite its exotic natural beauty the region presents a great danger which cannot be seen—multidrug resistant malaria.

Attack rates of malaria among new transmigrants in the Arso region have been very high. In one new village the prevalence of parasitemia increased from 0 percent on the first day after arrival in Irian Jaya to 42 percent by the end of the first month.(15) The usual point prevalence of malaria in more established villages ranges between 25 percent and 75 percent throughout the year. Over 85 percent of children and over 60 percent of adults have enlarged spleens as a result of chronic infection. Over 50 percent of patients infected by *P. falciparum*

and treated with chloroquine remain parasitemic after 7 days, i.e., in vivo resistance is very common. In vitro tests revealed resistance to quinine, fansidar, mefloquine, and amodiaquine. Resistance to chloroquine by *P. vivax* also seems to be present in the region. These problems are not so prominent among native populations because they possess a high level of naturally acquired immunity. In contrast, the recent arrivals from Java living in Irian Jaya reveal the full extent of the malaria problem, and their susceptibility to infection may be similar to that among American military personnel. These findings in the Arso region, all published in the medical literature,(4,6,9,15-19) serve as a foundation for more sophisticated field-based research.

From a humanitarian perspective, amelioration of sickness caused by malaria and other agents in the Arso region is an important goal of field work. From the perspective of the military research malariologist whose mission is the protection of military personnel, the presence of transmigrants in a heavily malarious area like Arso is a powerful analytical tool. One of the most satisfying aspects of malaria field work in the Arso region is that both goals, the humanitarian and the military, can be addressed together. If a control strategy, chemoprophylactic or chemotherapeutic regimen, or vaccine is effective among new transmigrants to Irian Jaya, it would almost certainly prove effective in American troops.

In the near future NAMRU-2 plans trials in the Arso area of prophylactic and therapeutic drugs, insecticide-impregnated mosquito nets, and a new, more reliable, field-based in vivo assay of resistance to chloroquine. Scientific and logistical preparations are being made for a malaria vaccine trial. These studies will provide information for the effective management



LT Mike Bangs training a local resident to collect mosquitoes landing to feed.

of malaria in troops and at the same time render humanitarian assistance to the residents of the Arso region.

Hospital-Based Studies. When villagers living in Arso or other communities in the Jayapura area develop severe malaria, they are referred to the Jayapura General Hospital for treatment. Here, intensive therapy can be offered to those with coma, seizures, profound anemia, renal failure, or other life-threatening conditions resulting from malaria infection. However, just as our efforts to control malaria transmission in the field have been frustrated, attempts to improve therapy for severe malaria have made little progress. Mortality rates from severe malaria have hardly changed in the last two decades. The Arso villager or the U.S. Marine with cerebral malaria continues to have a mortality risk of 20-30 percent despite optimal treatment. The Navy has identified the treatment of severe malaria as an important research priority.

In response, NAMRU-2 is conducting intensive studies of patients hospitalized with severe malaria. The location of our laboratory adjacent to the hospital has proven very beneficial. Work began at Jayapura General Hospital in 1986 with trials of intravenous steroids for the treatment of malaria coma.⁽¹⁴⁾ Today, our field sites have expanded to include Jayapura General Hospital and three additional hospitals in northern Sulawesi, another large Indonesian island to the west of Irian Jaya. In our current research, we are trying to define the mechanism by which brain damage occurs in cerebral malaria. This should allow us to supplement traditional drugs that kill malaria parasites with newer agents that reverse the damaging processes in the central nervous system that have been initiated by the malaria parasite. By 1994, we plan to have randomized, controlled trials of these agents under way in Irian Jaya and Sulawesi.

Additional Studies in the Laboratory and Field. The malaria research program at NAMRU-2 also includes

the immunologic evaluation of malaria antigens as possible vaccine components and studies of anopheline vector biology and taxonomy. NAMRU-2 provides hands-on training for Indonesian, American, and other foreign nationals in the microscopic diagnosis of malaria, the identification of mosquito vectors, and the cultivation of both parasite and vector in the laboratory.

In summary, malaria is a more common and increasingly dangerous public health problem in the tropics. This situation may threaten the operational readiness of American forces deployed to endemic areas. Using conventional means to manage malaria in a hostile fire zone, or even in rear areas, is complicated by an ordinarily fluid tactical situation, difficult logistics, human behavior, and by biological resistance to antimalarial drugs and insecticides. A safe and effective malaria vaccine may solve these difficulties, but such a vaccine is not yet in sight. NAMRU-2 and other DOD laboratories in the tropics and CONUS are working as a team to develop better conventional means of dealing with endemic malaria while also supporting vaccine development efforts.

References

1. Oaks SC Jr, Mitchell VS, Pearson GW, Carpenter CCJ, eds. *Malaria: Obstacles and Opportunities*. Washington, DC: National Academy Press; 1991:309.
2. World Health Organization, Division of Control of Tropical Diseases. World malaria situation, 1988. *Rapport Trimestriel de Sanitaires Mondiales*. 1990;43:68-79.
3. Rieckmann KH, Davis DR, Halton DC. *Plasmodium vivax* resistance to chloroquine? *Lancet*. 1989;ii:1183-1184.
4. Baird JK, Basri H, Purnomo, Bangs MJ, Subianto B, Patchen L, Hoffman SL. Resistance to chloroquine by *Plasmodium vivax* in Irian Jaya, Indonesia. *Am J Trop Med Hyg*. 1991;44: 547-552.
5. Schwartz IK, Lackritz EM, Patchen LC. Letter: Chloroquine-resistant *Plasmodium vivax* from Indonesia. *New Engl J Med*. 1991; 324:927.
6. Murphy G, et al. Chloroquine-resistant *Plasmodium vivax* in Irian Jaya, Indonesia. *Lancet*. 1992.
7. Slim W. *Defeat Into Victory*. 2nd ed. London: Cassel & Co LTD; 1956.
8. Beadle C, Hoffman SL. The history of malaria in the United States naval forces at war—from World War I to the Vietnam conflict. *J Clin Infect Dis*. 1992.
9. Baird JK, Basri H, Jones TR, Bangs MJ, Ritonga A. Resistance to antimalarials in Northeastern Irian Jaya, Indonesia. *Am J Trop Med Hyg*. 1991;44:640-644.
10. Gunawan S. The malaria situation in Irian Jaya. *Buletin Penelitian Kesehatan*. 1985;13:1-24.
11. Hoffman SL, Dimpudus AJ, Campbell JR, Marwoto HA, Sukri N, Rustama D, et al. RII and RIII type resistance of *Plasmodium falciparum* to combination of mefloquine and sulfadoxine/pyrimethamine in Indonesia. *Lancet*. 1985;ii:1039.
12. Hoffman SL, Campbell JR, Marwoto HA, Rustama D, Rai NK, Harun S, et al. Prolonged incubation improves the micro-scale in vitro test for drug sensitivity of *Plasmodium falciparum*. *Lancet*. 1984;i:7-9.
13. Hoffman SL, Campbell JR, Rustama D, Dimpudus AJ, Sarumpaet B, Rusch J, Marwoto H. Pyrimethamine-sulfadoxine still effective against *Plasmodium falciparum* in Jayapura, Irian Jaya: R-I resistance in 2 of 18 patients. *Trans R Soc Trop Med Hyg*. 1987;81: 276-277.
14. Hoffman SL, Rustama D, Punjabi NH, Sarumpaet B, Sanjaya B, Dimpudus AJ, et al. High-dose dexamethasone in quinine-treatment patients with cerebral malaria: a double-blind, placebo-controlled trial. *J Infect Dis*. 1988;158:325-332.
15. Baird JK, Jones TR, Bangs MJ, Purnomo, Masbar S, Ratiwayanto S, Leksana B. Evidence for specific suppression of gametocytemia by *Plasmodium falciparum* in residents of hyperendemic Irian Jaya. *Am J Trop Med Hyg*. 1991;44:183-190.
16. Baird JK, Jones TR, Danudirgo EW, Annis BA, Bangs MJ, Basri H, et al. Age-dependent acquired protection against *Plasmodium falciparum* in people having two years exposure to hyperendemic malaria. *Am J Trop Med Hyg*. 1991;45:65-76.
17. Baird JK, Purnomo, Masbar S. *Plasmodium ovale* in Indonesia. *Southeast Asian J Trop Med Public Health*. 1990;21:541-544.
18. Jones TR, Baird JK, Basri H, Purnomo, Danudirgo EW. Prevalence of malaria in native and transmigrant populations—effects of age and history of exposure. *Trop Geogr Med*. 1991;43:1-5.
19. Jones TR, Baird JK, Ratiwayanto S, Supriatman M. Glucose-6-phosphate dehydrogenase deficiency and hemoglobinopathies among residents of Arso PIR, Irian Jaya. *Buletin Penelitian Kesehatan*. 1990;18:16-21. □

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Naval Medical Research and Development Command Highlights

• Postinjury Enhancement and Modulation of Hematopoietic and Immune System Recovery

Following severe trauma to the immune system and blood-forming tissues caused by damaging chemical, biological, or radiation exposure in combat, patient survival and cell recovery depends on the ability of surviving stem cells to produce daughter cells and regulatory growth factors for the regeneration of all vital components. Biological proteins, such as the broad family of growth factors are powerful regulators of tissue repair, particularly after traumatic injury. Researchers in the Immune Cell Biology Program at the Naval Medical Research Institute, Bethesda, MD, are investigating specific regimens using human growth factors, lymphokines, cytokines, and other regulatory agents for the enhancement and modulation of blood-forming tissues and immune system recovery. One achievement, a culture system derived to cause growth of stem cells in simple laboratory tissue flasks, indicates that it is possible to obtain at least a millionfold increase in the population of stem cells and other hematopoietic cells. This system should permit the development of a new form of transfusion therapy using autologous (self) stem cells. The stem cells remaining in the bone marrow of injured personnel can be cultured, rapidly cloned, and readministered to restore bone marrow function. This system can also serve as an ideal platform for somatic gene therapy, where genes of interest can be introduced into the stem cell culture system, and the improved stem cells transfused for correction of genetic defects. For more information contact CDR P.D. Kent, MC, NMRDC Research Area Manager, Combat Casualty Care, DSN 295-0880 or Commercial 301-295-0880.

• A New System and Method for Quantifying Macrophage Phagocytosis by Computer Image Analysis

Current light microscopic examination and manual counting of particles in individual cells is the most common method of quantifying phagocytosis, but only a few cells can be analyzed and no quantitative morphometric data is obtained. Another method, flow cytometry, can quantify phagocytosis of many cells in suspension, but cannot provide detailed morphometric data. Researchers at the Naval Medical Research Institute, Bethesda, MD, have developed a new method and

algorithm for rapidly quantifying phagocytic functions using computer image analysis of video light microscopic images. This new image analysis procedure provides significantly faster phagocytic function analysis than manual microscopic examination and more detailed quantitative morphological data than flow cytometry. The procedure provides an accurate and rapid computer-assisted quantitative phagocytosis method that enhances immunological and pathophysiological lines of research by screening for and detecting the substance phagocytosability, the efficacy of immunization with bacterial extracts, the resistance of/ or to bacteria, and the wound healing process. For more information contact Mr. A. David Spevack, NMRDC Intellectual Property Counsel, DSN 295-6760 or Commercial 301-295-6760.

• Genetics of Motion Sickness

Motion sickness and disorientation are significant operational concerns for the Navy and Marine Corps. Current studies have documented an unacceptably high incidence of motion sickness in aircrew and shipboard personnel. Studies also have recognized that, in the underwater environment, sensory conflicts, body fluid redistribution, and nitrogen narcosis make Navy divers highly susceptible to motion sickness. Researchers at the Naval Health Research Center, San Diego, CA; the Wayne State University School of Medicine, Detroit, MI; and the University of Michigan Medical School, Ann Arbor, MI, are investigating a new approach to the problem of motion sickness. They are focusing on the cellular and molecular physiology of gene expression to determine if a predisposition to motion sickness is an inherited trait. Genetic differences in the complement of receptors on autonomic neurons of the central and peripheral nervous system could explain the differences in an individual's susceptibility to motion sickness. Preliminary findings suggest that a genetic polymorphism of the alpha-2 adrenergic receptor (encoded by chromosome 10) is associated with the development of motion sickness. This approach can also be used to understand the variations in human responses to other physical stresses in the operational environment, such as a predisposition to heat stroke or gravity-induced loss of consciousness. For more information contact Ms. Christine Eisemann, NMRDC Associate Director for Research Management, DSN 295-0882 or Commercial 301-295-0882.



Navy Medicine

March-April 1943

Jennifer Mitchum

Although the Guadalcanal campaign had officially ended, the advance in the Solomons continued. To deny the enemy bases in the central Solomons and to make them available for Allied forces, ADM William F. Halsey, Jr., set his sights on the Russell Islands, a small group of

islands about 30 miles northwest of Guadalcanal. "With their good harbors and excellent terrain for airstrips, they would make a good staging point for" (1) an Allied advance into New Georgia. In addition, with a patrol torpedo (PT) base, radar station, and airplane facilities established there,

Guadalcanal would be better guarded in its role as the base of future operations. Thus, immediately after the fall of Guadalcanal, ADM Halsey activated plans for occupying the Russells and forces landed there unopposed on 21 Feb 1943 in the midst of a tropical rainstorm. By month's end, more than



Photos from BUMED Archives

9,000 men were on the islands.(2)

On 13 March, the advance echelon of Marine Aircraft Group Twenty-one arrived at Banika, R.I., and began setting up camp. The remainder of the group arrived in April and all worked on the camp, usually 12-16 hours a day under almost constant rainfall and with limited food supply.

Accompanying medical personnel in the Russells were "sorely taxed."(3) Beginning in April, medicos saw their first medical crises—malaria, acute infections, jaundice, acute gastroenteritis, tonsillitis, pharyngitis, fungus infection, and infected sores.

In addition to providing medical care, personnel had their share of camp construction as well, setting up their Quonset huts and other buildings with little or no help. They established a central dispensary, which included a dental office, in the camp and set up an auxiliary sick call and emergency aid station at the air strip.

Navy medical personnel in the Rus-

sells consisted of 3 doctors, 2 dentists, and 39 corpsmen assigned to the headquarters squadron, and 1 flight surgeon and 7 corpsmen attached to each of the 5 aircraft squadrons.(4)

Advanced Base Components

The initial system of shipping advance base components to coastal assembly points intact was modified in March 1943. By that time, it had become apparent that Lions, Cubs, and Acorns were too large and included many components that were not required in all theaters of war, while some facilities that were required for certain operations were omitted. To remedy this, Lions, Cubs, Acorns, CASUs (Carrier Aircraft Service Units), and PT bases were subdivided into functional components and alphabetized, with numeral subgroups for the diversified units within the group.

The medical and dental components were designated as "G" components. Over time, BUMED designated components G-1 through G-10 as dispensaries and G-13 through G-16, which were dental units, as subdispensaries. In malarial areas, G-17 units were staffed with well-trained entomologists and had ample supplies and equipment to remedy malaria problems. In addition, G-18 epidemiology components were provided when new bases were established and until sanitation standards were met. Equipped with laboratory equipment and supplies, personnel could determine the source and type of organisms producing dysentery and other epidemic disease outbreaks. In addition, there were the G-20 and G-21 optical repair components, the first being the base type and the latter being mobile. There was also a rodent control component—G-22. After time, as part of an advance base and several expansion phases, some of the larger dispensaries were converted to fleet and base hospitals.

On 15 March, the Chief of Naval Operations issued the first edition of the catalogue of advanced base functional components, from which area commanders could choose the necessary functional components to comprise a Lion, Cub, Acorn, CASU, or PT base.

Navy Medicine in Amphibious Landings

Although the United States had entered World War II with no experience in employing medical units in opposed amphibious landings, planners had learned a great deal by spring 1943, and basic instructions for amphibious employment of medical units had been established by that time.(5) On 23 March, U.S.-advanced amphibious training bases were established in French North Africa at Beni Saf, Mostaganem, Nemours, and Tenes in Algeria and at Port Lyautey, Morocco. A dispensary was set up at Port Lyautey and smaller medical installations were active in the other areas.

On Espiritu Santo, New Hebrides, construction began on the medical facilities of Lion One. Lion One, which had been commissioned in the summer of 1942 at Moffett Field Naval Air Station, CA, was shipped to the Naval Advanced Base, Espiritu Santo in January 1943. Sanitation problems paved the way for fly- and mosquito-borne diseases in troops and hospital personnel. Hospital personnel suffered from a dengue-like disease in epidemic form, which affected up to 12 percent of personnel at times. In addition, dysentery, which was endemic among island residents, was a problem.

To begin rectifying the sanitation situation, Army and Navy medical officers appointed a base sanitary officer to inspect the area, report findings to the commanding officer, and recommend corrective measures. A malaria control unit was also formed.



A member of the malaria control unit in the South Pacific sprays the marshes and pools of stagnant water with insecticide to guard against mosquitoes.

As part of their comprehensive training at the Hospital Corps School, USNH Farragut, ID, prospective pharmacist's mates learned to make blood tests, slides, and other laboratory analyses.

Disease: An Ongoing Problem

The area surrounding Port Lyautey and the air base had the reputation of being the most malarial spot in all French Africa.(6) A Navy malaria control unit found that Arab huts and European dwellings near the base were infected with mosquitoes: In 1941, 40 percent of the French personnel at the base had malaria.(7)

Malaria, in turn, threatened the mission of the newly established naval air base. Control measures were necessary. Fortunately, U.S. forces had occupied the base shortly after the 1942 malaria season ended, and there would be several months before the 1943 season began. A malaria control team, composed of a malaria control unit and approximately 50 construction battalion personnel, cleared drainage ditches of vegetation, installed window and door screens, and regularly oiled collections of water that could not be drained. In addition, malaria control specialists indoctrinated base personnel in malaria discipline and took measures to correct deviate conduct. As a precautionary measure, liberty expired at sundown, and those working in the open or in unscreened buildings after dark were required to use mosquito repellents. Freon pyrethrum was sprayed in all living and sleeping quarters daily to kill adult mosquitoes.

Knowing the potential danger posed by neighboring communities, personnel constructed an extensive system of new drainage ditches in swamp areas near the base. In addition, planes flew low and dusted the lagoon regularly, initially with Paris green and later with DDT. French and Arab inhabitants living nearby thoroughly opposed such treatments "but their objections were overruled in the interest of the war effort."(8) Medical personnel also made Atabrine treatment accessible to



the inhabitants. Incidentally, the Arabs, who opposed the treatment from the start, were eventually relocated beyond probable mosquito-flying range in relation to the base.

By mid-April, U.S. and British Armies had made Atabrine mandatory as a suppressive treatment. The Navy, however, continued malaria control in the Port Lyautey area, using the region much like a testing ground to demonstrate the effectiveness of control measures. Malaria was not viewed as a problem at other U.S. naval bases in French North Africa. This was due in part to the low incidence of the disease in the areas where those bases were located and to anti-malarial regulations in effect at those bases.

Bacillary dysentery was also present in mild forms in North Africa as was acute gastroenteritis, which appeared in newly established bases affecting most personnel within a few days. Most patients recovered after about a week on a regular diet, a regimen of sulfaguanidine or sulfathiazole, and rest. Unsanitary conditions such as unscreened galleys and mess halls, and haphazard, incomplete fly-proofing of latrines, existed in areas where outbreaks occurred. Subsequently, efforts were made to improve sanitary condi-

tions. Administrative officers were indoctrinated in the basics of dysentery control and medical personnel were reeducated in the same principles and their responsibilities.

Pacific Hospitals

Malaria remained the chief disease of epidemiological concern at nearly all mobile and base hospitals. Of 870 patients at Mob-6 in Wellington, New Zealand, on 6 March, 660 or 76 percent had malaria.(9) Between 1 March and 17 March, 498 patients were admitted to the hospital with 1 death occurring on 13 March from malignant tertian malaria.(10)

On 17 March, Mob-6 was renamed and commissioned Base Hospital No. 4, and excess supplies from Mob-6's original construction were used to build a new Mob-6 in the Auckland area. Following the conversion, Base Hospital No. 4 reported that malaria remained a problem and that the greater part of malarial infestations were due to the *plasmodium vivax*. Consequently, the Malaria Control Unit opened a laboratory at Base Hospital No. 4 which served the activity and the Second Marine Division.

In addition to mainly serving the Second Marine Division, medical personnel continued to care for battle

LT Frank D. Dobyms, DC, USNR, is shown providing dental treatment in the first dental operating room commissioned at U.S. Naval Training Station, Farragut, ID.



casualties, but in fewer numbers. There were also fractures and burn cases.

It should be noted that the medical staff stayed in relatively good health. No epidemics, pneumonia, or frequent respiratory infections were reported among hospital personnel.(11) In addition, there were only two instances of serious illnesses, one which occurred before the hospital became Base Hospital No. 4. One case resulted in death, and the other, a man with carcinoma of the bladder, was evacuated to the States. From 17 to 31 March, 671 patients were admitted to the hospital.(12) In April, 1,385 patients were admitted.(13)

On 6 March, at Mob-4 in Auckland, LCDR James J. Sapero, MC, head of the malaria control program in the South Pacific, discussed and reviewed the latest control and treatment methods at a conference. In addition to Navy medical personnel, the conference was attended by the Army's 39th General Hospital and 1st Port of Embarkation medical staffers.

At Base Hospital No. 2, Efate, New Hebrides, cases of *plasmodium falciparum*, which initially constituted about 48 percent of the admissions, were on a continuous decline.(14)

Plasmodium vivax was also gradually decreasing. Atabrine was used to treat these conditions.

Expansion and improvements continued to be made at the mobile and base hospitals as necessary. In March, the Naval Construction Battalions began work on expanding the bed capacity at Mob-5 Noumea, New Caledonia, to 1,000 beds, and the first nurses arrived at the hospital via USS *Mount Vernon* on 25 March 1943.

Mob-7, which had been commissioned at the medical supply depot in Brooklyn, NY, on 9 July 1942, was also set up at Noumea. Manned with 32 officers and 249 enlisted men, the hospital was situated in what had been a cow pasture surrounded by hills. Personnel received their first pa-



Oil-coated survivors picked up by rescue vessels after German bombers attacked an Allied convoy off North Africa. The suffocating film of oil posed the threat of catching fire.

Coast Guard photo

tients—268—on 22 April.⁽¹⁵⁾ By the end of the second week of operation, there were 630 patients on board.⁽¹⁶⁾

Training Continued

As in previous months, training remained crucial to the success of the Navy Medical Department in the war. In March, the first group of women's reserves (WAVES) reported to Hospital Corps schools for instruction.

In aviation medicine training, corpsmen were taking courses designed to qualify them as low-pressure chamber technicians at sites such as the Marine Corps Air Station, Marine Corps Base, Quantico, VA.

Changes and Additions

As the war raged on, militarywide changes continued to occur. Earlier in the year, Ruth C. Streeter, became the first woman to be appointed a Marine major. The Navy broke with the tradition "that every man in blue was a volunteer," and began selecting men from the draft.⁽¹⁷⁾ Then on 4 April, the Navy launched *The Sullivans*, the first Navy ship with a plural name.

Within the ranks of Navy medicine, CAPT Alexander G. Lyle, DC, became the first appointed rear admiral in the Dental Corps on 13 March. By April, the task of recording Navy medical war history was under way as LTJG Chester L. Guthrie, H-V(s), from the National Archives, was assigned to the Office of the Special Assistant to the Surgeon General as records coordinator for BUMED.

In addition, a convalescent hospital was commissioned at Santa Cruz on 8 March and the USNH Memphis, TN, officially opened on 17 March 1943.

Worth Mentioning a Second Time

At the end of April, service personnel at USNH Parris Island, SC, set what may have been then a record in U.S. war bond sales to servicemen. Five days after the hospital began its bond drive, 100 percent of the enlisted personnel had made allotments to purchase war bonds for the duration. The allotments, which involved more than

10 percent of their income and were for an indefinite period, were automatically deducted from their pay.

ENS Armand P. Chartier, HC, was in charge of the bond drive. "The efforts of Ensign Armand Philip Chartier, (H.C.), U.S.N., in this bond drive and the patriotic response of the hospital corpsmen are highly commendable,"⁽¹⁸⁾ noted CAPT Clyde B. Camerer, MC, commanding officer of the hospital.

References

1. Karig W, Purdon E. *Battle Report: Pacific War, Middle Phase*, p 203.
2. The Russells. *U.S. Navy Medical Department Administrative History, 1941-1945: Narrative History*. Vol I, chaps I-VIII, sec two, p 35.
3. *Ibid.*, p 35.
4. *Ibid.*, p 36.
5. *The History of the Medical Department of the U.S. Navy in World War II: A Narrative and Pictorial Volume*; 1:167.
6. *Ibid.*, p 194.
7. *Ibid.*, p 194.
8. *Ibid.*, p 195.
9. History of USN Mobile Hospital No. 6 (June 25, 1942-March 17, 1943), p 11.
10. *Ibid.*, pp 11-12.
11. History of USN Base Hospital No. 4 (March 17, 1943-December 31, 1943), p 3.
12. *Ibid.*, p 2.
13. *Ibid.*, p 2.
14. Annual Sanitary Report 1943, con. U.S. Naval Base Hospital No. 2, p 63.
15. History of U.S. Naval Hospitals, vol II: all remaining hospitals including Special Augmented Hospital No. 6 Okinawa, p 541.
16. *Ibid.*, p 541.
17. Karig W, Burton E, Freeland SL. *Battle Report: The Atlantic War*, appendix A, p 410.
18. Camerer, CB. Marine servicemen set bond-buying record. Commendatory mention. *Hosp Corps Q*. October 1943;XVI(4), p 216.

Bibliography

- Annual Sanitary Report 1943, con. U.S. Naval Base Hospital No. 2. BUMED Archives.
- Bevan D. *United States Forces in New Zealand: 1942-1945*. New Zealand: Macpherson Publishing; 1992.
- Camerer CB. Marine servicemen set bond-buying record. Commendatory mention. *Hosp Corps Q*. October 1943;XVI(4). BUMED Archives.
- Davis WD. Hospital Corps training at Marine barracks, Quantico, VA: courses for low-pressure chamber technicians at the Marine Corps Air Station. *Hosp Corps Q*. July 1943;XVI(3). BUMED Archives.
- Dictionary of American Fighting Ships, Volume VI: R-S—Appendices, Submarine Chasers, Eagle-Class Patrol Craft*. Naval His-

tory Division, Office of the Chief of Naval Operations, Navy Department. Washington, DC: Government Printing Office; 1976.

History of USN Base Hospital No. 4 (March 17, 1943-December 31, 1943). BUMED Archives.

History of USN Mobile Hospital No. 6 (June 25, 1942-March 17, 1943). BUMED Archives.

History of U.S. Naval Hospitals, vol II: all remaining hospitals including Special Augmented Hospital No. 6 Okinawa. BUMED Archives.

Hospital corpsmen commended. *Hosp Corps Q*. July 1943;XVI(3). BUMED Archives.

Johnson LW. Report on Lion One Medical Facilities. BUMED Archives.

Journal of the Medical Department: January 1939-June 1944. Unpublished handwritten log in BUMED Archives.

Kane JN. *Famous First Facts*. 3rd ed. New York: The H.W. Wilson Co; 1964.

Karig W, Burton E, Freeland SL. *Battle Report: The Atlantic War*. New York: Rinehart & Co Inc; 1946.

Karig W, Purdon E. *Battle Report: Pacific War, Middle Phase*. New York: Rinehart & Co Inc; 1947.

Paper on Base Hospital No. 6. BUMED Archives.

Register of Commissioned and Warrant Officers of the U.S. Navy and Marine Corps: July 1, 1943. Washington, DC: Government Printing Office; 1943.

Register of Commissioned and Warrant Officers of the U.S. Navy and Marine Corps: July 1, 1944. Washington, DC: Government Printing Office; 1944.

The History of the Medical Department of the U.S. Navy in World War II: A Compilation of the Killed, Wounded, and Decorated Personnel. Washington, DC: Government Printing Office, 1953.

The History of the Medical Department of the U.S. Navy in World War II: A Narrative and Pictorial Volume. Washington, DC: Government Printing Office; 1953.

United States Naval Chronology, World War II. Prepared in the Naval History Division, Office of the Chief of Naval Operations, Navy Department. Washington, DC: Government Printing Office; 1955.

U.S. Navy Medical Department Administrative History, 1941-1945: Narrative History. Vol I, chaps I-VIII. Unpublished typescript. BUMED Archives.

U.S. Navy Medical Department Administrative History, 1941-1945: Narrative History. Vol I, chaps IX-XVIII. Unpublished typescript. BUMED Archives.

U.S. Navy Medical Department Administrative History, 1941-1945: Organizational History. Vol II, chaps I-IX. Unpublished typescript. BUMED Archives. □

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Disinfection of a Sewage Contaminated Fresh Water Holding Tank at a Remote Shore Facility: Potential for Illness and Injury

CAPT Richard G. Hibbs, MC, USN

Fresh water contaminated by sewage poses potential risks to exposed persons of viral and bacterial gastroenteritis, giardiasis, amebiasis and other protozoal diseases, typhoid fever, salmonellosis, shigellosis, schistosomiasis, and viral hepatitis.(1) Safe drinking water standards are provided in federal, OPNAV, and MEDCOM guidelines and instructions.(2-5) Other sources of guidance are the Naval Environmental and Preventive Medicine Units (NAVENPVNTMEDU) in San Diego, CA; Norfolk, VA; Hawaii; and Italy, and the Naval Environmental Health Center in Norfolk, VA.

The membrane filter technique is one of several procedures to determine the microbiological quality of water. These tests detect fecal coliforms (*Echerichiae coli*, *Klebsiella pneumonia*, and *Enterobacter aerogenes*) usually present in the large intestine of warm-blooded animals. A positive test indicates sewage contamination of a clean water source.

Disinfection of contaminated potable water sources is most often accomplished by chlorination. The levels of residual chlorine measured in parts per million (ppm) required to effect percentages of bacterial kill are related to the Ph and temperature of water and the contact time. For example, at low-water temperatures and/or higher Ph, as well as at higher concentrations of chlorine binding substances such as organic matter, higher residuals of chlorine are needed for bacterial kill. Bacterial diseases are easily prevented by water chlorination.

In the United States, bactericidal chlorine levels are standard in water supply systems. Higher chlorine levels, which are cysticidal and presumably viricidal, are recommended for areas endemic for amebiasis, giardiasis, or hepatitis A. The city of Cairo, Egypt, chlorinates to 2 ppm due to pathogens endemic to its water source, the Nile River.

Health precautions for waste water treatment system personnel(6) are appropriate for anyone working in contact with raw sewage. Current immunizations for typhoid, polio, and tetanus are advised and immune serum globulin for hepatitis A should be considered. Such precautions are also recommended for international travelers to developing countries.(7)

Proper protective equipment is essential when working with sewage contaminated water systems. Serious potential gaseous hazards are associated with sewage in confined spaces; hydrogen sulfide, sulfur dioxide, methane, ammonia, and carbon dioxide are the principal hazards. Decreased oxygen or chlorine gas caused by superchlorination are also potential hazards. Any confined space containing sewage must be assumed to contain toxic gases or vapors until proven otherwise.

All these elements—enteric pathogens, superchlorination and worker hazards—became critically interlinked factors when a sewage line serving both a fever hospital and a Navy Medical Research Facility in Cairo became blocked. Raw sewage backed up in the basement of the six story U.S. Naval Medical Research Unit No. 3 (NAMRU-3) Basic Science Building (BSB), contaminating the 64,000-gallon fresh water holding tank in the facility, threatening more than 100 workers and scores of research projects.

The Problem

NAMRU-3 was established in 1946 in Cairo, adjacent to Abbassia Fever Hospital, the city's largest fever hospital (1,500 beds) which has been in operation since 1892.* NAMRU-3 is considered a remote naval facility since the

*See "Marco Polo in the Land of the Pharaohs," *Navy Medicine*, November-December 1992.

nearest Naval Support Facility (with preventive medicine expertise) is in Naples, Italy. In 1983, NAMRU-3 opened a six-story BSB for bacterial, parasitic, and viral research directly adjacent to the fever hospital.

The municipal water which NAMRU-3 uses for potable water is an essentially unlimited supply of chlorinated water, although there is usually no detectable free available chlorine (FAC). Three systems were constructed within the BSB to handle waste water. Sanitation drains from toilets flow directly into municipal sewage. The sixth floor biocontainment area is drained into a containment waste system where it is heat-treated to 300°F before being discharged into the municipal sewage. Laboratory sinks drain into a limestone filter pit before discharge into the municipal sewage system. The municipal sewage line receives effluent from both the BSB and Abbassia Fever Hospital. A safety valve at the end of the NAMRU-3 sewage line, approximately 10 yards from the BSB, prevents backflow from the city sewage line into the NAMRU-3 system.

In December 1990, the municipal sewage line became obstructed 10 yards downstream from the connection between the facilities. Raw sewage from Abbassia Fever Hospital flowed out of manholes and ran onto the street and grounds of NAMRU-3. The backflow safety valve functioned properly since no sewage appeared in toilets in the BSB, so the source and quantity of contamination of the freshwater holding tank was sewage overflow of the concrete barrier caused by flooding in the basement. The only NAMRU-3 structure with a basement was the BSB, where over 6 inches of standing sewage water had accumulated. The NAMRU-3 Public Works Division determined that the flooding had overflowed the 6-inch concrete safety barrier to the 64,000-gallon holding tank for potable water.

Solution

Immediate efforts were directed toward unblocking the municipal sewage drain pipe to stop the overflow flooding. Cooperation between the NAMRU-3 plumbing team and local municipal plumbers achieved success within several hours. After the municipal sewage pipe was unblocked, the fresh water holding tank was drained, an all-day process. The basement was evacuated and notices were liberally posted on all floors of the BSB informing personnel not to drink or touch any water that would flow from the faucets throughout the building when the system turned on.

The BSB basement was cleared of standing water and disinfected using 200 ppm FAC solution (1) and waiting for complete dryness. The NAMRU-3 cleaning personnel wore protective clothing and worked under close supervision.

The fresh water holding tank presented a problem of a different magnitude. The access doors in the basement of the BSB open onto a vertical ladder extending below the

basement level into the two-story holding tank. The recommended decontaminating procedures (5) for a holding tank include flushing and disinfecting or spraying and swabbing the walls and surfaces with a specified concentration of solution. Public Works personnel were eager to descend into the tank and scrub it with chlorine solution. However, the status of the air (O₂ level or other gases) in the tank was unknown and neither a gas-free engineer nor special respiratory protection were available. Scrubbing the water tank was not considered safe under these conditions, so after consulting with the Naval Environmental and Preventive Medicine Unit No. 7 (NEPMU-7), Naples, Italy, it was decided to chemically disinfect the large tank by superchlorinating to 100 ppm FAC and allowing 4-hour contact time with no less than 50 ppm FAC. The tank was then refilled and chlorinated to at least 0.2 ppm. After 30 minutes contact time the tank water was tested bacteriologically by membrane filter method (7) and determined to be safe.

The entire clean-up process took 3 days. There were no injuries, illnesses, nor unusual episodes during the following 12 months. The successful, safe decontamination of the fresh water tank and the expertise in enteric and other infectious diseases of NAMRU-3 physicians, scientists, and technicians working in the BSB contributed to the lack of illness.

This report describes a major contamination of a potable water system with raw and most probably infectious sewage. It emphasizes the significant illnesses that pose a risk from sewage contaminated water and the illnesses and injuries that may result from disinfection of a large, confined sewage contaminated space. These potential illnesses and injuries must be considered whenever such a contamination occurs. The problem is especially acute for remote shore facilities which may lack expertise and/or equipment to safely and effectively correct this type of contamination.

References

1. Naval Medical Command. *Manual of Naval Preventive Medicine*, NAVMED P-5010 (Rev 9-87), chap 5.
2. National Primary and Secondary Drinking Water Regulation (guidelines) in Title 40, *Code of Federal Regulations*, parts 143 and 141, respectively.
3. OPNAV Instructions, *Environmental and Natural Resources Protection Manual*.
4. MEDCOM Instruction 6240.1 Series, *Standards for Potable Water*.
5. *Manual of Naval Preventive Medicine*, NAVMED P-5010 (Rev 9-87), chaps 5 (Water Supply Ashore) and 6 (Water Supply Afloat).
6. *Ibid.*, chap 7 (Waste Water Treatment Disposal, Ashore and Afloat).
7. Grevberg AE, Rhodes R, Clesceri LS, eds. *Standard Methods for the Examination of Water and Waste Water*. 1985:866-870. □

CAPT Hibbs is commanding officer of NAMRU-3 in Cairo, Egypt.

Navy Medicine 1945



BUMED Archives

An instructor adjusts a flight nurse's oxygen mask in the hypobaric chamber at the School of Air Evacuation of Casualties (AEC), NAS Alameda, CA. Experience in handling flight gear for extreme altitudes was essential in caring for patients undergoing aeromedical evacuation.

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